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## On social knowledge, ideology and the nuclear power debate

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ON SOCIAL KNOWLEDGE, IDEOLOGY AND  
THE NUCLEAR POWER DEBATE

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Thesis presented to the Open University  
in fulfilment of the requirements for  
the Degree of Doctor of Philosophy

April 1984

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## Statement

None of the material offered in this thesis has been submitted for a degree or other qualification at the Open University or any other institution.

Some of the material has been published in preliminary and outline form in 'The Nuclear Controversy: Unequal Competition in Public Policy Making' ERG 045. Energy Research Group, Open University, 1980.

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## Abstract

Many of the issues and problems concerning the role of our frameworks and structures of reasoning in the guidance of the process of social and technological development are encapsulated in the debate about nuclear energy. This thesis takes that debate as a context for analysing the rationality of scientific knowledge of society and the role and influence of such knowledge in debate and decision-making about appropriate forms of social and technological development.

After an introductory review of the historical, political and economic context of the issues and of the development of UK energy policy over the last 25 years, the body of the thesis is structured into two parts. In the first part, a critical examination of orthodox conceptions of scientific objectivity is followed by an attempt to elaborate an alternative conception of the nature of the rationality of social scientific knowledge founded upon the notions of 'value-contingency' and 'ideology'. This conception is developed through discussions of the role of social problem-solving in providing a basis for the process of knowledge development and of the role of the state in structuring the problem-solving process and the development of social knowledge to provide a complex 'technical' legitimacy framework. The concept of a dominant 'technocratic ideology' is then elaborated and an attempt made to identify and outline the major cognitive and normative components of this ideology. In particular it is conceived of as presenting interrelated ideological accounts of the appropriate form of knowledge development, of the content of the social world and of the appropriate form of knowledge utilisation, which are underpinned by 'materialistic', 'liberalist' and 'rationalist' normative traditions.

The second part of the thesis analyses certain aspects of the debate about nuclear energy in order to attempt to identify the role and influence of the 'technocratic ideology' and its normative commitments as elaborated in the first part, with a view to assessing the validity and implications of such a conception. After a review of the major issues of controversy in the debate, covering the economic, safety, environmental, social and political implications of nuclear energy, an attempt is made to clarify and categorise the main dimensions of the dispute in terms of the perception and valuation of economic benefits and 'social costs'. Arguments in support of nuclear power are then examined, themes of 'technocratic rationality' identified and the implications for the conduct of the debate discussed.

Two particular aspects of the debate are then examined in detail to identify the influence of normative, ideological themes. Firstly, pro-nuclear perceptions and interpretations of the energy problem are analysed and liberalist and materialist themes identified; in particular tendencies towards the establishment of 'materialist ethical imperatives' are highlighted. Secondly, aspects of the process of consideration of alternative means to the 'solution' of the energy problem are examined including illustrations of the value-contingent nature of the relevant social knowledge, an analysis of the treatment of the issue of demand-side solutions in pro-nuclear arguments, and a brief discussion of the implications of technocratic rationality for the evaluation of the costs and benefits of nuclear power. Finally, conclusions are drawn on the evidence for the influence of technocratic rationality and the normative themes identified, on the political implications of such dominant ideological themes and on limitations of the analysis and further research directions.

## Preface

"Unless either philosophers become Kings in their countries or those who are now called Kings and rulers come to be sufficiently inspired with a genuine desire for wisdom; unless, that is to say, political power and philosophy meet together, . . . there can be no rest from the troubles for states, nor yet, as I believe, for all mankind ..."

Thus Socrates outlined for Adeimantus, in Plato's 'Republic', the nature of the ideal State in which 'Philosopher-Kings' were to rule on the basis of real knowledge. Since Plato's time there has been a continuing concern amongst political philosophers, and, more recently, political scientists, with the relationship between human reason and social action to create desirable forms of social and political organisation. Many theoretical positions, with complex interrelated systems of descriptive and normative commitments, have been propounded yet we might look at our contemporary world and wonder about the nature of the benefits of more than two thousand years of human intellectual effort. Economic and technological development, interacting to define a conventional conception of 'progress', has nevertheless presented new and ever more complex dilemmas to test the human capacity for problem-solving. While such development simultaneously enhances, in material and 'quantitative' terms, our capacity for addressing the problems it creates, there remain those doubts concerning the 'quality' of human reason and action which came to underpin Plato's pessimism about the inevitable progression to tyranny.

Of all the challenges facing humankind in today's world, that presented by the question of the development of nuclear energy may not be the most fundamental but it is nevertheless a deep concern of many people. Moreover, it can be seen as encapsulating many of the issues



that are at stake in the guidance of the process of social and technological development. It provides, therefore, a context for the attempt to examine the broader problem of the role of our frameworks and structures of reasoning in the processes of developing appropriate actions to guide such development. The aim of this thesis is modest in relation to the enormity of the wider task: essentially it attempts to shed some light on the nature of the present relationship in our society between the 'scientific' knowledge of society on the one hand and social action on the other, and to elaborate the implications of the analysis with reference to the debate about nuclear power development.\*

The structure of the thesis can be briefly outlined. In chapter one the background to the study is described covering the general historical, political and economic context, followed by a review of the development of UK energy policy over the last 25 years. The body of the thesis is then structured into two parts. Part one, entitled 'Social Knowledge and Ideology', incorporates chapters 2-6 and is concerned with examining the nature and rationality of social scientific knowledge and developing a conception of its role in informing social action in our society. In chapter two the major controversies in the philosophy of science are reviewed, while chapter three extends the review to social scientific knowledge, and develops a critique of the orthodox view of rationality with reference to the field of economic knowledge. Chapter four attempts to move towards an alternative conception of the nature of the rationality of social knowledge founded upon notions of 'value-contingency' and 'ideology'. In chapter five this conception is elaborated with reference to notions of 'social problem-solving' and the theory of the role of the State. Finally in

\* Some of the arguments developed in this thesis were published in a preliminary and outline form in Sanderson (1980).

Part One, chapter six attempts to identify the content of a 'dominant technocratic ideology' and, in particular, the nature of its normative underpinnings.

Part Two of the thesis is entitled 'Ideology and the Nuclear Power Debate' and includes chapters 7-9. It is concerned to analyse certain aspects of the debate about nuclear energy in order to attempt to identify the role and influence of the technocratic ideology as elaborated in the first part. Chapters 7 and 8 present a review of the major controversies in the debate, the former being concerned with the economic issues while the latter covers arguments relating to environmental, social and political implications. In chapter nine certain themes in the debate are analysed at some length. Firstly, an attempt is made to clarify the main dimensions of the dispute and provide a categorisation of the debate and this is followed by an analysis of the extent to which arguments for nuclear power tend to illustrate the themes of the dominant technocratic ideology. The analysis is then further elaborated with reference to two particular aspects: firstly, the perception and interpretation of the 'energy problem'; and, secondly, the process of consideration of alternative means to its solution. The latter aspect includes a detailed look at the nature of the knowledge brought to bear upon the process, an examination of the treatment of demand-side alternatives, and a consideration of certain issues surrounding the evaluation of costs and benefits. Chapter nine concludes with an examination of some possible political implications of ideological themes. Finally, chapter ten outlines some general implications of the analysis and critically examines what has been achieved.

Notwithstanding the custom of long and flowery acknowledgements, I wish to make few, and briefly: to various members of the Energy Research Group for friendship, help and encouragement which I shall always value, especially Mark, David, Glenda and Liz; to Cath for her support at crucial times; and to Jake for his help and supervision.

At the risk of appearing to seek to elevate this work into something more than it is, I should like to dedicate it to those who strive for peace, freedom and equality in the world: a constant source of inspiration albeit as diminishing oases of hope in an increasingly barren world.

PART ONE : SOCIAL KNOWLEDGE AND IDEOLOGY

"It is the absolutist assumptions of ... positivism which have led most sociologists to see objectivity as the necessary outcome of the mechanical application of their rules of verification."

"The complexity of social problems in a technological and urbanized world makes the effective application of sociological knowledge to our social problems the crucial determinant of our society's future."

Jack Douglas (The Relevance of Sociology)

"The ganglion of post-industrial society is knowledge .... Every society now lives by innovation and growth; and it is theoretical knowledge that has become the matrix of innovation."

Daniel Bell (The Coming of Post-Industrial Society)

"Only an intellectual barbarian is likely to maintain that reality is only that which can be grasped by scientific methods."

"As the physicists are busy engineering the world's annihilation, the social scientists can be entrusted with the smaller mission of engineering the world's consent."

Peter Berger (Invitation to Sociology)

## Chapter 1: Introduction

### 1.1 Rationality and Social Problems

Philosophers have long agonized over the 'raison d'être' of human existence and no doubt will continue to do so as long as the human species survives. But this may not be for very long. For, whatever this 'raison d'être' might be, we have contrived, through the conscious development of scientific and technological means, to bring ourselves to the brink of self-destruction. It may represent a despairing cynicism to rationalize the whole of human history in terms of such a possible end but, nevertheless, a growing pessimism about the future of humankind is understandable in the present context. As Alvin Gouldner has argued:

"Optimism wanes as the promise of technological expansion is seen to have approaching ecological limits and when scientific achievements threaten a military peril of planetary proportions. Now, once-rosy optimism has greyed and gives way to a growing sense of being lost in history. There is no longer a sense of riding an upward drift and the dimming prospect reopens once-closed Malthusian issues."  
(Gouldner 1976 p. 16)

Of course, it is possible to argue in response that it could have been different and that we shall survive in the future to a more noble end. The former argument must remain in the realms of metaphysical speculation, but the latter provides the fundamental focus for all the remaining forces of optimism about the human condition. Whether we shall survive long if present trends continue is open to question but we surely can shape for ourselves a future which bypasses the threats of the present and develops new potentialities for long-term realization.

The shaping of such a future represents a considerable challenge to those who have the vision. It may indeed involve fundamental changes in our institutions and in our ways of thinking about social development. And many of those who have the vision of such a future are not in a position to effect change or even present arguments which will be acknowledged as valid and reasonable. Such problems are a recipe for disillusionment, discontent and protest, for increasing alienation of those who become labelled as 'radicals', for increasing recourse to political activity bypassing the 'legitimate' channels which fail to accommodate such 'radical' arguments.

Moreover, there is a multitude of problems facing our society, less fundamental than that of human survival, which greatly compounds the challenge. Much has been written about the demise of the Western advanced capitalist economies which are experiencing severe problems of stagnation, inflation and unemployment with attendant social consequences. The destruction of our natural environment has increasingly become a focus of concern for many, some of whom regard this, indeed, as one of the major threats to our survival. The plight of our cities has received considerable attention especially in respect of housing, transport and environmental problems. During the past decade, the energy problem facing the advanced industrial nations has achieved some pre-eminence. An important dimension of such problems concerns the distribution of wealth and resources. As material wealth is continually expanded through the development of scientific and technological means, the persistence of poverty amidst affluence becomes increasingly problematical. This is the case not only within the advanced capitalist nations but also on a global scale between advanced industrial nations and less developed nations and such

distributional issues represent major sources of tension and challenge to public policy making systems.

The ability of policy making systems to respond to such challenges has become, especially in recent years, the focus for a considerable research effort. Research concerned to analyse the nature and 'adequacy' of the response of such systems and, indeed, their rationale in relation to various social needs, interests and objectives is now firmly established within the field of political science. The work reported in Lindberg (1977) provides an example of such research in relation to the energy policy systems of advanced industrial nations. Now, the process of public policy formulation can be conceived of as involving both the exercise of political power and the application of knowledge in order to reach decisions and take actions to attempt to solve, or at least alleviate, perceived problems in a system of interest. Consequently, there are two possible foci for analysis of policy-making systems: firstly, the ways in which political power is exercised in the process; and, secondly, the nature and influence of knowledge and ideas which are brought to bear upon the solution of problems.

The relative importance of these two sets of influences on policy formulation is extremely difficult to assess and, indeed, is likely to vary according to the nature of the problem and the circumstances of the attempt to solve or alleviate it. My major concern in this study is to analyse the nature and influence of knowledge and ideas as applied to the consideration of public policy issues in order, firstly, to provide some indication of the degree of importance of such influence and, secondly, to assess the implications for the

nature of policy outputs. It will, hopefully, then be possible to develop some insights into the potential for the achievement of alternative futures for our society through the application of reason - the attribute of human existence which provides the primary basis for whatever claim to 'civilization' we can make.

The motivation for this study arose primarily from my experience in local authority planning where it became apparent to me that widely accepted models of the planning process, and particularly of the role of social scientific knowledge in that process, had little basis in actual practice. In particular, the degree of controversy which develops over public policy issues is difficult to reconcile with conception of objective social knowledge which one usually finds underlying discussions of rational planning processes; attempts to rationalize such disputes with reference to right/wrong, rational/irrational, logical/emotional dichotomies then appear to be totally unsuccessful, indeed misconceived. Moreover, it appeared to me, at least on the face of it, that there is a significant degree of 'pre-formulation' of policy solutions, something of an 'inevitability' about the outcomes of policy-making processes, which underlies the veneer of the rational consideration and full evaluation of all possible options.

Although formulated largely in an urban planning context, these ideas appeared to have a much broader relevance and, in pursuit of a developing interest in energy policy issues, I began, in late 1978, an attempt to assess their validity in relation to such issues. It is really only during the last decade that energy has come to be perceived as a distinct problematic, emerging as such, with the oil



price shocks of the early 1970s, from the more general concern with the problem of resource shortages which had been developing during the late 1960s and which was manifested in the so-called 'doomsday literature'. The prospect of net energy self-sufficiency due to North Sea hydrocarbons tended to dull the perceived urgency of the energy problem in the UK throughout the 1970s, especially compared to countries such as France and West Germany where the anticipation of continued heavy reliance on imported oil resulted in rather greater strains on the policy-making machinery. Nevertheless, energy policy issues have received considerable attention in this country, particularly the question of the future role of nuclear power which provides an excellent example of a very deep and passionate controversy in relation to problems of social and technological development. In view of the importance of this issue, and, indeed, of energy issues in general to our social and economic future, I feel that it is important to attempt to gain some insights into the problem of the 'rationality' of arguments about such issues.

## 1.2 Historical and Political Context: The Emergence of 'Crisis'

In order to develop further the basic problematic of the study it is useful to refer in more detail to the appropriate historical and political context. The steady economic growth and continuity of social development of the late 1950s and early 1960s engendered a mood of considerable optimism about social, economic and technological futures. This mood is often characterized by Harold Wilson's 'white-hot technological revolution' and his designation of the 1960s as the 'New Age' of prosperity and social harmony. Economic instability was seen as a thing of the past since Keynesian economic science provided

the means to manage and 'fine tune' the economy. Harmony, participation and integration were seen as characterizing the modern polity heralding the ideal of the pluralistic society with a multiplicity of interests, dispersion of economic and political power and guarantees of individual freedoms (cf. Lindberg 1976).

Technological advance was seen as an inevitable process providing, in conjunction with scientific research, the potential for the solution of all remaining social problems. This optimistic view of technological development has achieved a rather deep-seated influence in our society; as François Hetman has argued:

"... technological change is widely accepted as an essential element of economic development. Economic growth is based on gains in productivity which can be realised only through the infusion of new knowledge and technology. As on the productive side, technology has enormously increased the range of opportunities open to consumers. In all sectors of human life, advances in communication technology have led to rapid information, advances in transport technology to greater mobility and easy access to any place on the planet, advances in medicine and health technology have led to substantially greater life expectancy and relief from suffering."

(Hetman 1977 p. 4)

The so called 'Post-war consensus' is frequently invoked to characterize this situation but there have always been dissenting voices. During the first two post-war decades, however, opposition to and denial of 'materialist' values and concern for the adverse consequences of economic and technological growth was confined to relatively small groups with little political influence. As long as the economic system continued to 'produce the goods', and in the post-war atmosphere of cold war politics, little credence was given to the prophets of doom and revolution.

However, during the late 1960s and early 1970s, fissures began to appear in the optimistic façade essentially generated from two major sources. Firstly, there was an increase in the strength of the critique of the adverse consequences of economic and technological progress reflected in growing disillusionment and protest particularly amongst young people. Secondly, this trend was reinforced by the development of severe contradictions and destabilizing forces in the advanced Western economies which brought into question their ability to fulfil the materialist expectations which they had promoted. It is appropriate to consider these developments in rather more detail.

Although criticisms of technological progress had little impact before the late 1960s, they were in fact achieving high levels of sophistication and elaboration more than a decade earlier. As early as 1958, Hannah Arendt was writing about the de-humanizing effect of modern technological society:

"The question therefore is not so much whether we are the masters or slaves of our machines, but whether machines still serve the world and its things, or if, on the contrary, they and the automatic motion of their processes have begun to rule and even destroy world and things."  
(quoted in Williams 1971 p. 32)

Also during the 1950s, Jacques Ellul's 'The Technological Society' was published in France presenting a devastating critique of technical progress as producing the domination of humans by 'technique', turning society into an 'affair to be managed', the state into 'nothing but a huge machine', and democracy into 'mere appearance' (Williams op. cit. p. 33). A new totalitarianism is founded upon technical necessity with state propaganda facilitating mass manipulation:

"Technique must reduce man (sic!) to a technical animal, the king of the slaves of technique. Human caprice crumbles before this necessity; there can be no human autonomy in the face of technical autonomy."  
(Ellul quoted in Roszak 1970 p. 6)

Ellul's pessimistic theme was developed during the 1960s by Herbert Marcuse and Theodore Roszak. Marcuse (1964) argued that technical progress in advanced industrial society expands the potential for satisfying wants but simultaneously erodes human rights and freedoms producing a totalitarian productive apparatus, a 'non-terroristic economic-technical coordination' which manipulates needs and generates a 'pattern of one-dimensional thought and behaviour' justifying the oppressive nature of the system and insulating society from the possibility of liberating change. In Marcuse's view, therefore:

"... technology has become the great vehicle of reification - reification in its most mature and effective form. The social position of the individual and his (sic!) relation to others appears not only to be determined by objective qualities and laws, but these qualities and laws seem to lose their mysterious and uncontrollable character; they appear as calculable manifestations of (scientific) rationality ..... The web of domination has become the web of Reason itself, and this society is fatally entangled in it. And the transcending modes of thought seem to transcend Reason itself."  
(Op. cit. p. 168-9)

Roszak (1970) further articulated the critique (first published in 1968) defining the 'technocracy' as the 'mature product of technological progress and the scientific ethos', in which all aspects of social life (politics, education, leisure, entertainment, culture as a whole) become the subjects of purely technical manipulation by specially trained experts. In other words, technocracy is:

"... that society in which those who govern justify themselves by appeal to technical experts who, in turn, justify themselves by appeal to scientific forms of knowledge. And beyond the authority of science, there is no appeal."  
(Op. cit. p.8)

This critique of technical progress and technological society was, naturally enough, not well received by those who supported the view that liberal democratic and pluralist political institutions were still alive and well and who subscribed to the optimistic view of technological progress as a benign and liberating force (cf. Douglas 1974). However, there were also criticisms from many of a Marxist persuasion who found it difficult to accept the crushing pessimism of, in particular, the work of Ellul and Marcuse. The major point of controversy concerned the idea that technical progress had become an independent force determining goals, methods and their application and therefore replacing the political process based on interests arising from social relations in a capitalist economic system. For example, Jürgen Habermas in 'Toward a Rational Society' (1971), while supporting Marcuse's view of the political implications of instrumental technical reason, nevertheless argued that:

"The direction of technical progress is still largely determined today by social interests that arise autochthonously out of the compulsion of the reproduction of social life without being reflected upon and confronted with the declared political self-understanding of social groups."  
(Op. cit. p. 60)

Consequently, Habermas saw technological progress as still under the control of politics and determined by value systems - by historically determined interpretations of need - however much values are reduced to technical imperatives through the ideology of 'technocratic

consciousness'. What is required, Habermas argued, is political change to abolish technological rationality and bring relations between technical progress and the 'social life-world' under the control of rational public discussion based on action and transaction structured in ordinary language:

"It is ... a question of setting into motion a politically effective discussion that rationally brings the social potential constituted by technical knowledge and ability into a defined and controlled relation to our practical knowledge and will."  
(ibid. p. 61)

Habermas' critique of the technological society, somewhat less pessimistic than those of Ellul and Marcuse, indicating the immanent and vital potential for political change, is perhaps the most forceful to date (cf. Cotgrove 1975). The central theme of this 'technocratic critique' - the political implications of a technical reason underpinned by the rationality of modern empirical science - was echoed, to an extent, in the growing concern in the late 1960s and early 1970s with the environmental and ecological consequences of rapid industrial and economic growth as manifested in the surge of 'doomsday literature' expressing a profound pessimism about global resource and environmental problems. The Ecologist's 'Blueprint for Survival', the Club of Rome's 'Limits to Growth', and writers such as Ehrlich (1970) and Daly (1971) all emphasized the finiteness of the world and the imminence of severe resource scarcity due to the expansionist and materialist 'growth ethic' of advanced industrial society.

The influential analysis presented by Ward and Dubos (1972) provides an example of this concern. They argued that humankind has been brought to the brink of a global crisis by three primary factors.

Firstly, the development of reductionist Western science, with its orientation to usefulness derived from reliability based on measurement and controlled experimentation, has increased our knowledge and power of manipulation and change but, with its specialized and atomistic tendencies, has simultaneously eroded the influence of natural ecological 'checks and balances' (op. cit. p. 48-53). Secondly, the economic logic of the market place has increasingly dominated as the 'human wisdom' that guides the development of human societies producing enormous social and environmental costs and "... intolerable strains on what had appeared to be the planet's limitless resources." (ibid. p. 62). Thirdly, the emergence of the nation-state provided the basis for industrialization, imperial commercial expansion and international conflict and war, all essential ingredients in the global crisis (ibid. p. 62-6).

That these critiques of advanced industrial/technological/capitalist societies had considerable socio-political significance is indicated by the rapid growth, particularly from the early 1970s, of the 'environmentalist movement' from a previously limited social base to include a wide spectrum of social groups with differing interests, values and interpretations of the 'environmental problem' (Cotgrove 1976; Cotgrove and Duff 1980; Sandbach 1980). Now, although an important part of the environmentalist movement is composed of "... preservationist and conservationist groups whose policies constitute no kind of challenge to the dominant value system, and are in this sense basically conservative..." (Cotgrove 1976 p. 24), there is nevertheless a significant 'utopian' element which seeks to use environmental problems as a lever to promote fundamental social change (ibid. p. 25). It is this 'utopian environmentalism' which is

essentially the product of the pessimistic thought of the 1960s and early 1970s, based upon both the doomsday literature and the radical critiques of technological progress in advanced industrial society and images of the counter-culture. (cf Cotgrove 1982 chapter 1).

Consequently, the environmentalist movement has increasingly brought into the political process a radical protest against the dominant values of 'industrialism'. In this sense, it cuts across traditional political categories providing a different orientation to the Marxist-based critique of 'capitalism'. Its focus on scientific rationality, on modes of consciousness, on resource and environmental consequences of industrial and technological development contrasts with the traditional Marxist concern with the capitalist mode of production and the structure of social relations generated from it as the basic determinant of the 'contingent' environmentalist problematic. Utopian environmentalism can therefore be seen as lying more easily with the analytical foci of Ellul, Marcuse and Roszak than with the 'new-Marxism' of Habermas. Its radical nature derives, then, primarily from 'romanticist' themes: the critique of reductionist, atomistic, manipulative science and an argument for more subjectivist, holistic approaches to the relations between nature and society; the rejection of the process of modernization, industrialization, technical progress and the extension of instrumental rationality which banishes discussions of values and ends to the realm of 'irrationality' (Cotgrove 1978B; 1976 p. 26-30 1982; Sandbach op. cit. p. 25-7).

The force of such growing critical thought and protest was strengthened by the emergence in the late 1960s and early 1970s of severe contradictions and de-stabilizing trends in the advanced Western economies



which provided little comfort for the optimists. The situation in Britain was not untypical of the general problem. By the late 1960s inflationary pressures were becoming quite severe as increasing wage costs in a near 'full employment' situation were transferred to prices (Currie 1980). As the economy began to stagnate efforts by government to stimulate domestic demand via public spending resulted in significant increases in the quantity of imported goods and this caused a deterioration in the balance of payments problem. From 1970 prices of raw materials in world markets began to increase sharply, especially in the case of oil after the formation of the OPEC cartel, and this aggravated the dual problems of stagnation and inflation. Then in 1973/74 the massive increases in the price of oil following the Yom Kippur War exacerbated an already difficult economic situation and, indeed, triggered off the worst slump since the Second World War (ibid.).

Throughout the 1970s, then, Western governments were basically preoccupied with attempts to overcome this economic crisis. But the persistence of such problems began to cast severe doubts on the ability of the state in advanced capitalist societies to manage the economy and maintain growth and investment. More specifically, the Keynesian approach to macro-economic management, which only a few years earlier had seemed to be a panacea, was now increasingly questioned in a situation where economic recession, growing unemployment and high rates of inflation occurred simultaneously. Indeed, such questioning was extended to the whole concept of state 'intervention' in economic and social life resulting in a growing predilection for a return to 'laissez faire' doctrines as expressed in Friedmanite Monetarism (Gamble 1979; Jacques 1979). Moreover, this apparent failure of the

state in respect of economic management was aggravated by growing challenges to its authority. Two sources of such challenges can be seen as of particular importance. Firstly, the militancy of organized sections of the working classes increased in the face of attempts by the state to control public expenditure and inflation (ibid.). Secondly, the level of protest and opposition from the environmentalist movement increased in response to government attempts to promote economic growth through investment in industrial and technological developments. The resulting situation can be seen as involving something of a 'crisis of government' - a dilemma of the state - involving, on the one hand, severe problems for the machinery of public policy formulation and, on the other, simultaneous trends which considerably increased uncertainties thus eroding the capacity for response of that machinery and its ability to successfully tackle such problems.

### 1.3 The 'Rational Planning' Response

These latter trends are of fundamental importance to the issues addressed in this study and therefore will bear somewhat closer examination. Given such a dilemma it would become important for the state to attempt to reduce the uncertainties which hinder its ability, in particular, to handle problems of economic instability. This implies two major lines of action firstly, to increase information concerning the nature of the problems which are perceived as requiring a policy response and, secondly, to reduce the obstacles to effective political action by increasing the degree of loyalty to and support of the state from all (or at least most) social classes and groups - in other words to increase the legitimacy of the state. Indeed, from

the late 1960s and throughout the 1970s there was an increasing emphasis placed on the 'relevance' of social scientific research where 'relevance' can be interpreted in relation to the requirements of the state for better information in order to increase the policy-making effectiveness (see, for example, Lindblom and Cohen 1979). In particular, one can point to the rapid growth in econometric modelling during the 1970s as the epitome of 'relevant' social scientific knowledge.

As regards the second line of action, the attempt to maintain a widespread basis of political support has taken several forms. For example, considerable amounts of public expenditure have gone into the maintenance of the Welfare State to support those disadvantaged in the process of economic growth and maintain their support for dominant values and goals. However, such a strategy is double-edged in that the high levels of public expenditure required when economic problems are severe and the need to maintain popular support is consequently greatest, cause an exacerbation of the 'fiscal crisis' and, therefore, of the original economic difficulties (Caldwell and Woolley 1976). This aspect of the dilemma has indeed been in evidence in recent years in Britain and many other advanced capitalist democracies.

A further strategy which has been adopted by the state to reduce the obstacles to effective political action involves the control and management of dissent and opposition. For example, throughout the 1970s governments in Britain attempted to impose various means of controlling the power of opposition of the trades unions to their strategies of economic management; such attempts ranged from informal agreements to 'industrial relations' legislation (Jacques 1979). Also

during the 1970s the 'Public Inquiry' became the official means of harnessing and controlling the opposition of the environmentalist movement to industrial and technological developments, bestowing upon dissenting groups the feeling that their views are receiving the proper attention within the democratic political process (cf. Pearce et al. 1979).

An important further component in such a strategy, moreover, involves the 'management of consent, belief, trust and attention' (Forester 1982) so as to increase support for governmental approaches to problem-solving and to devalue the impact of opposition and dissent. Much of this is achieved through 'natural' processes of socialization which are supported by the state (Sherman and Wood 1979 ch.9). For example, our education system is concerned to propagate certain fundamental beliefs, a primary theme being respect for legitimate authority as embodied in our basic institutions - the family, state, church etc. (ibid. p. 209-17; Cotgrove 1978A p. 96-103; Miliband 1973 p. 213-26). The elected government in representative democracy is conventionally portrayed as acting in the best interests of all groups in society and, therefore, as legitimately commanding the respect and support of all responsible members of society (ibid. p. 4-6). However, in recent years, there would appear to have been something of a decline in support for traditional institutions and sources of authority (cf. Cotgrove 1978A p. 163-4; Habermas 1976B; Offe 1976). This decline has been particularly marked amongst younger people and can be related to the increasing support, discussed earlier, for critics of technological society; it can be seen as contributing in no small measure to the dilemma of the state. Consequently, it can be argued that there has arisen a need for 'new' sources of authority and trust in advanced

industrial societies, sources which, ideally, could be referred to 'above' the emergent disillusioning uncertainties of politics and morality.

The growing call for 'relevance' in social scientific research during the 1970s, in order to increase its usefulness in government policy-making activities, was referred to above in relation to the first possible path out of the dilemma of the state. But the increasing tendency for the justification of public policies with reference to 'the findings of science' and the 'informed opinions of experts' indicates a role for scientific knowledge and expertise as a new source of authority and trust employed by the state to obtain support for, and acquiescence in, its approaches to the solution of perceived problems. This suggests a dual role for social scientific knowledge in public policy making - as a source of effectiveness and as a source of authority. But the value of social science in this role is contingent upon its being conceived as embodying a special, indeed unique, cognitive power; upon its being conceived (as indicated above) as 'above' the realms of politics and morality. In other words, to be of value to the state in overcoming its dilemma, social scientific knowledge must be presented as objective, untainted by value considerations, and embodying the truth about the social world.

The value of such a conception of social knowledge to the state can be considerable. To the extent that such knowledge is indeed reliable then greater confidence is justified in the ability of policy makers to solve problems; and if knowledge is objective then policies based on the application of such knowledge will have greater legitimacy. Moreover, those in possession of such knowledge can

command respect as 'experts'. Finally, the institutions of the state can then argue that those who oppose their policies and strategies must be ignoring the 'findings of science' and the 'truth' and basing their arguments on falsehoods or on 'subjective' and 'irrational' factors. The legitimacy of such opponents can therefore easily be undermined.

The dominant tradition of theory about the role of social scientific knowledge in public policy making is founded upon just such a notion of 'objective knowledge'. Most commentators on the theory of planning tend to subscribe to a form of definition of that activity as illustrated in the influential work of John Friedmann who conceives of planning in terms of the linkage between knowledge and action to achieve societal guidance (Friedmann 1973A, 1973B, 1978; Friedmann and Hudson 1974). For example, the following definitions of planning appear in Friedmann's work:

"... an activity centrally concerned with the linkage between knowledge and organized action ... therefore located precisely at the interface between knowledge and action."  
(op. cit. 1974 p. 2)

"... guidance of change within a social system ... reason acting on a network of ongoing activities through the intervention of certain decision structures and processes ..."  
(op. cit. 1973A p. 346-7)

"Planning refers to the application of a scientific and technical intelligence to organized actions."  
(op. cit. 1973B p. 19)

Such a conception of planning has been supported by Faludi (1973) and by Rose (1974) the latter, for example, defining planning as:

"... an activity by which man (sic!) in society endeavours to gain mastery over himself and to shape his collective future by power of his reason."  
(ibid. p. 23)

This view of planning displays an essentially rationalistic basis and, indeed, planning has tended to be reduced, in mainstream thinking, to a problem of rational decision-making with the focus on the intellectual dimension (how to make 'intelligent decisions') at the expense of a wider political perspective (how to take 'appropriate action' to achieve social change). For example, in his earlier work, Friedmann is concerned with the 'use of technical intelligence' and the 'intervention of certain decision structures'; moreover his conception of appropriate intelligence is revealed in a reference to the "... verifiable knowledge which alone is capable of serving as a sound foundation for a theory of planning." (Friedmann 1973A p. 346-7). In his influential 'Planning Theory', Faludi (1973) argues that 'planning has always meant taking intelligent, rational action' and places the emphasis on 'deciding on a course of action' (ibid. p. 35-8). Moreover, the quality of such decisions is improved to the extent that they follow from the application of knowledge derived from the 'scientific method' (ibid. p. 39). Therefore, Faludi sees the aim of planning as concerned to remove the barriers to, and promote, 'human growth' via the development of 'societal self-awareness' through the development of knowledge by the scientific method (ibid. p. 41-5; 49-51).

The dominance of the rationalistic conception of planning is reflected in the well-established 'rational-comprehensive' model of the planning process setting out the familiar logical sequence of goals - alternatives - prediction - evaluation - implementation - monitoring (Friedmann and Hudson 1974 p. 8; Grabow and Heskin 1973 p. 106-8).

Following Friedmann (1973B) this model can be seen as comprising four distinctive characteristics. Firstly, the model is comprehensive in its attempt to balance all explicitly-stated objectives, to harmonize competing claims on resources and to forecast all relevant external conditions. Secondly, the model is founded upon the criterion of optimal choice which requires a conception of equilibrium balance amongst the variable components of the planning system. Thirdly, the conditions of comprehensiveness and equilibrium produce a requirement for synthetic, quantitative models of the relevant systems resulting in a descriptive emphasis. Finally, the model embodies a functional rationality in presenting planning as a 'rational', 'objective' activity concerned with establishment of optimum means for the achievement of ends which are determined externally through the political process from which planners are independent (ibid. p. 53-9).

The rational-comprehensive model of policy-making is, therefore, firmly based in the context of 'objective consciousness' (Grabow and Heskin op. cit.), founded upon a conception of 'scientifically-schooled intelligence' which is free from the distortion of subjective value considerations and which therefore permits reliable advance knowledge of the outcomes of any course of social action. Various modifications to the model have been made to accommodate what are perceived as 'political realities' and 'limits to human rationality' resulting in such concepts as 'bounded rationality', 'satisficing' and 'disjointed incrementalism' but such developments have not fundamentally questioned the underlying assumptions concerning the nature of appropriate knowledge for policy making.

This model of planning and its relationship to social scientific knowledge can be seen as an important element in the efforts of the



state to maintain an input of loyalty and support as a basis for its attempts to solve perceived social and economic problems. The model can be seen as promoting confidence and acquiescence in the activities of the state by generating an impression of thoroughness, competence and accuracy based on reliable knowledge and expertise. However, its success in this respect has been far from complete. Although it remains the dominant rationalization by planners and policy makers of their own activities it has not silenced the critics of rationalism in advanced industrialist/capitalist society; indeed, it has provided a wider basis for their challenge. Certain more recent trends have therefore added some force to the critiques of the social, political and environmental consequences of scientific and technological progress.

Firstly, there has been an increasing awareness of the limitations to the ability of 'mainstream' social scientific knowledge to provide a firm foundation for policy formulation in the face of increasing complexity of social and economic problems, of technological systems and of the ways in which such systems interact with society (Dickson 1981 p. 62-3). This is particularly so in the case of the quantitative models which are regarded as the ideal form of knowledge within the rationalist conception but which are necessarily based upon the abstraction of a limited number of variables and relationships and upon a restricted conceptualization of the processes of social change (cf. Friedmann 1973B p. 101-2; Friedmann and Hudson op. cit. p. 8). For example, recent economic trends in advanced capitalist societies have presented a severe challenge to the orthodox theories and models of neoclassical economics and have produced a state of some uncertainty in the discipline. The fields of economic, sociological and political theory are all presently attempting to approach the problem of

explaining the relationships between technological development and social change but there is considerable controversy over the ability of existing theoretical frameworks to provide 'acceptable' explanations. A particular problem in this area can be seen as the continued pursuit of enquiries within the confines of traditional disciplines when an understanding of complex social systems really requires a broad multi-disciplinary approach. The ability of knowledge produced in one discipline, or of experts trained in that discipline, to comprehend the situation in all its complexity may therefore be highly circumscribed.

Moreover, as the critique of industrialism and technological growth has developed, and as the environmentalist movement in particular has gained in support, the controversy over issues of economic and technological development has emerged increasingly into the public gaze. Over the past decade there has been a substantial increase in such issue-directed political action aimed especially at challenging government policy decisions and in the resulting public controversies scientific knowledge and expertise has been widely employed by all disputants in order to support and legitimize their arguments. But claims of a 'scientific basis' for opposing arguments on a particular issue necessarily result in some questioning of the 'neutrality' and 'objectivity' of scientific knowledge and experts and increasing doubts about their legitimacy role (Nelkin 1979A, 1979B). In recent years the public inquiries over, for example, the energy-related developments at Windscale and the Vale of Belvoir would certainly seem to have encouraged such doubts about the role of social scientific knowledge in providing a rational basis for public policy formulation.

Throughout the past decade there has also been a growing recognition of the gulf that exists between rationalist-intellectualist conceptions of the relationship between social scientific research and policy making on the one hand, and 'political reality' on the other. Thus, the rationalist model has been criticized for its focus on intelligent decision-making, abstracting from the essentially political nature of the policy-making process and neglecting, for example, constraints on practical action (cf. Friedmann and Hudson op. cit.). Further, it has been argued that the intellectualist approach totally neglects the particular requirements of politicians and the nature of their task. Problems arise, then, from the contrast between the rather ambiguous nature of political action and the precise, technical nature of academic research; from the different conceptual frameworks and languages of politicians and academics which create difficulties of communication; and from the fact that the political process often demands rapid, 'rough and ready' and immediately relevant information whereas academic research requires a relatively lengthy time-scale for more thorough investigation (cf. Higgins 1980).

Such developments have produced a growing current of criticism of the dominant rationalist and intellectualist models of public policy making which has added weight to emergent themes of anti-rationalism and anti-industrialism. The trend is manifested, for example, in the increasing recognition that disputes and controversies over issues of social and technological development are not simply resolvable with reference to the 'facts of the matter' (i.e. with reference to objective scientific knowledge) but involve complex questions relating to disputes over values and social goals which influence perceptions of the issues and which cannot be settled on a factual basis. In other words, there is

growing acceptance of the view that public policy issues cannot be adequately considered in abstracted isolation from their wider political context, that arguments over values and ends on the political level cannot be dismissed as 'irrational', and that there are limits to the degree to which 'scientific analysis' of the issues can produce progress towards 'rational policy making'. This latter relationship is, therefore, increasingly regarded as problematic and, consequently, has itself become the subject of growing dispute.

#### 1.4 The Development of UK Energy Policy

The emergence of such a critical viewpoint can be illustrated with reference to the development of controversies over energy policy issues in this country. In order to place such developments in context it will be useful to review briefly the evolution of UK energy policy during recent years. In the following outline references are omitted to avoid repetition but are indicated in Annex 1 together with the relevant diagrams.

The United Kingdom is the second largest consumer of primary energy in Western Europe, behind West Germany, with a total consumption in 1982 of about 187 million tonnes of oil equivalent (mtoe). Thanks to North Sea hydrocarbons, Britain is now virtually self-sufficient in energy with imports accounting for less than 6% of gross inland consumption of primary fuels. The UK energy situation is conventionally characterised in terms of the 'four fuel economy' with primary energy consumption being supplied mainly by coal and oil (c. 36% each), natural gas (c. 23%) and nuclear power (c. 5%). Hydro electricity provides the remainder.

This situation is very different from that pertaining in the immediate post-war years when coal provided over 90% of all primary energy. Oil began to make significant inroads in the post-Suez period as prices fell with the expansion of production in the Middle East and Africa and by 1960 a 'two-fuel economy' had emerged with oil providing a quarter of primary energy and coal most of the remaining three quarters (Annex 1, Fig.1.1). During the 1960s the contribution of oil continued to increase rapidly as it replaced coal in domestic heating, rail transport and industry, and as private car ownership and road building advanced. Attempts were made to protect the coal industry during the early 1960s but oil was providing 35% of consumption by 1965, expanding to 45% by 1970. Coal production therefore declined from over 200 million tonnes in 1960 to 132 million tonnes by 1973, with a steadily increasing proportion being used in electricity generation. Natural gas began to make a contribution only after the discovery of the Ekofisk field in the North Sea in 1969 and provided 12% of primary energy by 1973. After the success with natural gas substantial oil discoveries were made in the North Sea and between 1971 and 1973 starts were made on the commercial development of 15 oil fields; however, in 1973 nearly all oil needs had still to be imported.

During the 1960s the consumption of electricity almost doubled and provided 12% of total delivered energy by 1973. A significant proportion of increased production over this period was provided by oil-fired capacity but there was also an increasing contribution from nuclear power (Fig.1.3). The first civil nuclear programme for the UK was started in the late 1950s and involved the construction of 4.5 GWE of nuclear plant based on the Magnox gas-cooled reactor through to the late 1960s. It was anticipated in the mid 1950s that nuclear plant

would provide a quarter of all electricity production by 1970; the achievement was, in fact, only 7%. However, the second nuclear programme was decided upon in 1965 after much controversy based on the advanced gas-cooled reactor (AGR) although only 6GWE were eventually ordered.

Therefore, by the early 1970s the UK had achieved the 'four fuel economy' comprising coal, oil, natural gas and nuclear electricity. However, it is notable that the overall rate of growth in primary energy consumption over the previous 20 years was relatively low in comparison with many other advanced industrial nations. Thus, total consumption increased by 54% between 1950 and 1973 and by 25% between 1960-1973; the increase in Gross Domestic Product (GDP) over the latter period was, by comparison, about 47%. This was due primarily to the substitution of oil and gas, which have a higher conversion efficiency from primary to useful energy, for coal in final consumption. For example, a particularly significant trend involved the replacement of coal burned in open fires by oil, gas and electric space heating in the domestic sector whereby a given amount of useful heat could be obtained with less delivered and primary energy input. It is apparent, therefore, from Figure 1.2, that delivered energy consumption in the domestic sector increased only marginally (3.5%) between 1960 and 1973; in industry such substitution was slower and more difficult so delivered energy registered a 20% increase over the same period. Despite the substitution of coal by oil and electricity in rail transport, the transport sector is dominated by the significant increase in private car ownership and use which, of course, relied totally on oil; consequently, this sector registered the highest increase over the period (47%). The largest increase in electricity

consumption in the decade up to 1973 took place in the domestic and tertiary sector largely due, again, to the replacement of coal fires by electric heating at a higher overall efficiency, and to the rising consumption of durable goods (Fig.1.4).

For much of this period such changes occurred within a political context which was, by and large, perceived as unproblematical. Immediately after the Second World War there were fuel shortages which prompted the establishment of the Fuel and Power Advisory Council and later the Committee on National Fuel Policy. The former, under the chairmanship of Sir Ernest Simon, reported in March 1946 and was primarily concerned with the efficiency of domestic heating in view of the new Labour Government's massive house-building programme. Efficiency of fuel use to ease energy shortages was also a prime concern of the Committee on National Fuel Policy which reported, under Viscount Ridley, in 1952. This report established the major objective of fuel policy as securing adequate supplies of fuel to meet the demands of the community and during the following two decades this concern eclipsed considerations of efficiency of use as the switch to cheap oil, in particular, progressed.

As there were, from this perspective, few perceived problems in the energy field, little progress was made towards a coordinated national policy until the mid-1960s when two issues arose which required some rationalization. Firstly, the discovery of natural gas under the North Sea produced the need for decisions to be made on questions of premium uses and pricing. Secondly, at the time of the announcement of the second nuclear power programme, electricity demand forecasts had to be reduced because of a slowdown in economic growth and this

necessitated decisions on future investment in different types of electricity generating capacity. After a review of fuel policy in 1965, the Labour Government produced the Fuel Policy White Paper in 1967 to reassess the balance of supplies in the emerging 'four fuel economy' with a view to securing adequate supplies of cheap energy to promote economic development. The White Paper was optimistic about oil supplies and price and about the potential of nuclear power and therefore confirmed the run-down of the coal industry. Priority was to be given to natural gas, particularly for use in the domestic sector, and to nuclear power; it was assumed that oil would be readily available as a balancing fuel.

This perspective was, however, overtaken by events in the early 1970s after the creation of the OPEC cartel. The trends initiated by the 1971 Tehran and Tripoli Agreements were catalyzed by the Yom Kippur War and the subsequent massive increase in oil prices created severe economic problems. In 1974 the cost of oil imports accounted for two thirds of Britain's visible trade deficit of £5.3 billion. The 'energy problem' became a matter of serious concern to government primarily because of its severe economic implications at a time when the performance of the advanced Western economies was already deteriorating. The major preoccupation of the Labour Government elected in March 1974 was, as in most other western European countries, one of reducing dependence upon imported oil through the promotion of indigenous production and energy conservation. However, an important factor in this country was the prospect of achieving self-sufficiency in oil within a decade or so through production from North Sea fields, a prospect which few other major consuming countries could look forward to. No new comprehensive statement of energy policy was



produced during the years immediately following the 1973/74 crisis despite the creation of the Department of Energy in December 1973. However, the Labour Government did implement a number of measures which were considered necessary to adapt UK energy policy to the new situation. These measures related to the conservation of energy and to the development of 'indigenous' energy production in the form of coal, oil and nuclear electricity.

The initial energy conservation policy introduced in 1974 relied primarily on voluntary measures, information and pricing although prior to 1975 the nationalised industries were prevented from passing on full cost increases to consumers in order to control inflation and consequently sustained large deficits. However, after 1975, prices were raised in line with costs in the interests of achieving conservation, and policies for energy saving were strengthened at the end of 1977 with the announcement of a ten-year conservation programme designed to save around 11 mtoe each year. Public expenditure of £450 million was sanctioned for the period up to 1981 to finance insulation and energy management in public buildings, grants for investment in energy saving equipment in industry and for insulation of private houses, and to finance information services and demonstration projects. The 'Save It' public information campaign was also extended and a new Energy Conservation Division was established within the Department of Energy. In 1979 new mandatory thermal insulation standards for non-domestic buildings were introduced. However, energy conservation policy remained relatively weak in many areas, particularly in the transport and industrial sectors, and was criticized as inadequate by the International Energy Agency in their reviews of member states' policies. Although UK energy consumption did decline

after 1973 this was largely due to economic recession, and with the temporary recovery in 1976 consumption began to grow once more at pre-1973 rates. Thus, between 1975 and 1979 consumption increased by 10% overall and by nearly 14% in transport and households and commerce.

The supply-side response to the 1973/74 crisis was considerably stronger and more comprehensive reflecting the orientation of energy policy objectives inherited from the 1960s. Soon after its election in 1974 the Labour Government set up a Tripartite Group involving the National Coal Board (NCB), the Unions and the Government to review the prospects for the coal industry. The 'Plan for Coal' produced by the NCB in 1973 was endorsed setting a production target of 135 million tonnes by 1985 and involving considerable investment both in new capacity and in the improvement of existing capacity. Early in 1977 the Tripartite Group published 'Coal for the Future' which set a planning objective for the industry of 170 million tonnes by the year 2000, of which 150 million tonnes would be deep mined, requiring 60 million tonnes of new capacity and an investment programme of £400 million per annum at 1976 prices. However, progress in new mine development soon fell behind schedule and forecast production levels have been reduced to about 125 million tonnes in 1985 and 137 - 155 million tonnes in 2000. Coal production actually declined to 122 million tonnes in 1979 and demand has been maintained by schemes covering purchases by the Central Electricity Generating Board who take over 70% of domestic output.

Substantial measures were also taken in 1975-76 to ensure greater public control over the development of offshore oil resources through state regulation and participation and through fiscal policy. In

1975 the Petroleum and Submarine Pipelines Act was passed enabling the Secretary of State for Energy to exercise additional control over exploration, development and production, and therefore to determine, within certain constraints, an appropriate depletion policy. The Act also established the British National Oil Corporation (BNOC) as the principal agent of State majority participation in the North Sea oil fields. Again in 1975, the Oil Taxation Act introduced a Petroleum Revenue Tax (PRT) designed to ensure that a substantial proportion of net revenues from offshore production remained within the UK and were therefore available for the attainment of wider economic objectives. The rate of PRT was increased from 45% to 60% in the 1979 Finance Bill and by the middle of 1979 the Government had received around £1.2 billion in taxation and royalties from the North Sea.

Production of oil from the North Sea commenced in 1975 in the Argyll field and 1976 production amounted to 12 million tonnes expanding rapidly thereafter to the current level of about 80 million tonnes per year. This gives the UK net self-sufficiency at a lower level of output than previously anticipated due to reductions in consumption since 1979. Forecasts of production for 1990 have been reduced to around 90 million tonnes and thereafter a decline is expected to about 60 million tonnes by the end of century. Estimates of resources remaining in existing discoveries have been reduced to 2.3 billion tonnes.

Since 1973 sales of natural gas have doubled and its contribution to total primary energy consumption has increased from 12% to 21%; it now supplies 30% of final energy consumption and plays a particularly important role in the domestic sector, its major premium market. In

1973 the Area Gas Boards were abolished and the British Gas Corporation (BGC) established with a virtual monopoly over the purchase and supply of offshore gas. Most of the gas produced during the 1970s has come from the Southern Basin of the North Sea but newer discoveries in the Northern Basin have alleviated concern about rapid depletion. Indigenous production increased between 1973 and 1979 by 36% to 39 billion cubic metres while imports, mainly from the Norwegian sector of the Frigg field, increased to about 10 billion cubic metres. The policy of low gas pricing to promote sales (and control inflation) was changed in 1975 and gas prices to industrial consumers have risen significantly since then although they continued to fall in real terms in the domestic market until the middle of 1980.

The final supply-side component in the Government's response to the 'energy crisis' concerned the fourth element of the 'four fuel economy' - nuclear power. The first two nuclear power programmes produced orders of about 10 GWE of capacity based on the Magnox and AGR reactors. Most of the first Magnox programme had progressed reasonably well to schedule although the final (and largest) reactor at Wylfa was delayed and did not commence operation until 1971. The second programme of AGR reactors soon ran into serious difficulties and severe construction delays were experienced especially, for example, at Dungeness B which is now coming on stream 11 years late and at a real cost 110% above the original estimate. In 1973 the Central Electricity Generating Board (CEGB) sought the approval of the Government for a programme of 36 nuclear power stations based on the American pressurised water reactor (PWR). However, after criticism of this proposal by the Parliamentary Select Committee on Science and Technology early in 1974, the newly elected Labour Government rejected

it in favour of a much smaller third programme of 4 GWe based on the steam generating heavy water reactor (SGHWR), the prototype of which had been developed at Winfrith by the Atomic Energy Authority (AEA). However, slow progress with the SGHWR led to a review of this option in 1976 in relation to the alternative AGR and PWR technologies. In January 1978 the Government finally decided to abandon the SGHWR option, to order two further AGRs as soon as possible (at Heysham and Torness), and to develop further the option of adopting the PWR system in the early 1980s in order to avoid exclusive dependence on any one reactor system.

Between 1973 and 1974 electricity consumption actually declined because of lower demand from the industrial sector and the rate of growth since then has been depressed by the economic recession, rising fuel costs and competition from natural gas, particularly in the domestic sector. Coal has increasingly been used to substitute for oil and natural gas in electricity production, as the delays in the AGR programme have prevented new nuclear capacity from coming on stream, and because of the failure of even the commissioned AGRs to operate to design capacity. However, optimism about the future growth in electricity demand and about the economic and technical performance of nuclear power stations continued throughout the 1970s leading to official expectations of a doubling of capacity between 1979 and 1990 and a further trebling between 1990 and the end of the century. Work continued throughout the 1970s with the AEA on the Fast Breeder Reactor (FBR) programme. In 1974 a start was made on the commissioning of the 250 MW Prototype Fast Reactor at Dounreay and it achieved full power output in 1977.

During the period after 1974 increasing attention was also given to the examination of the potential contribution of renewable energy sources in the UK but the effort was confined to a rather limited research and development budget. In 1976 work commenced, through the Advisory Council on Research and Development (ACORD), on the formulation of a comprehensive national strategy for energy research and development, and renewable energy sources were identified as a priority area for R & D funding. Programmes were established in the areas of wave, solar, wind and geothermal energy between 1976 and 1977 and work continued on the assessment of the potential for a tidal barrage in the Severn Estuary. Total public sector R & D funding for energy between 1976 and 1979 reached a level of about £240 million per year and although the funding for renewable sources increased towards the end of the decade, it did not achieve more than 3% of the total (compared with 70% for nuclear technologies).

Consequently, during the mid-1970s there was a considerable amount of government action in the energy field much of it within the context of concern with broader problems of economic management and oriented primarily to the question of securing supplies of energy to ensure economic growth. The resulting focus on issues of 'indigenous' energy production created increasing concern at the environmental costs of the developments implied in official thinking. For example, the proposals for new mining capacity contained in the 'Plan for Coal' and 'Coal for the Future' produced concern about local environmental damage. There was some protest, particularly in Scotland, against the environmental implications of oil and gas-related development in coastal areas. However, it was the nuclear power issue which constituted the focus for the major 'environmentalist' opposition

and two events of the mid-1970s can be seen having considerable significance for those who were challenging not only official policy but also dominant approaches to thinking about questions of social and technological development.

The first event was the publication, in September 1976, of the Sixth Report of the Royal Commission on Environmental Pollution on 'Nuclear Power and the Environment'. Under the chairmanship of Sir Brian Flowers the Commission produced a report which did much to establish the 'respectability' of arguments opposing the development of nuclear power by voicing substantial and well-reasoned doubts about many aspects of such development. The Commission argued that there were severe risks associated with the plutonium economy, for example, dangers of terrorist action and of erosion of civil liberties due to measures which might be necessary to reduce such dangers. They pointed out that " ... it would be irresponsible and morally wrong to commit future generations to the consequences of fission power on a massive scale unless it had been demonstrated beyond reasonable doubt that at least one method exists for the safe isolation of ... wastes for the indefinite future." Serious doubts were also expressed about the official view of a substantial reliance on nuclear-generated electricity by the end of the century on the grounds of wastefulness in energy terms and environmental implications. The Commission argued, therefore, that a major commitment to nuclear power should be postponed as long as possible in the hope that it may be avoided altogether. Finally, and quite significantly, the Commission saw the issues raised by nuclear power as 'political and ethical' as well as technical and felt that decisions on major questions of nuclear development should be made by 'explicit political process'.

Therefore, as well as providing a 'legitimate' basis for opposition to many aspects of nuclear power development, the Royal Commission report can also be seen as adding force to the challenge to the 'instrumental rationality' approach to thinking about social and technological policy issues, by arguing that political and ethical value considerations necessarily underlie the controversy. This argument subsequently gained further impetus through a second significant event viz. the establishment of a Public Inquiry into the application by British Nuclear Fuels Ltd. (BNFL) to build a major new thermal oxide fuel reprocessing plant (THORP) at Windscale in Cumbria. The Inquiry took place between June and November 1977 and resulted in the granting of a special development order for BNFL to proceed with the construction of the proposed reprocessing facility. Although the opponents of BNFL's development in particular, and of nuclear power in general, felt that the Inquiry Inspector, Mr. Justice Parker, failed to pay due regard to their arguments, the Inquiry can nevertheless be seen as having resulted in a wider appreciation of the argument that the debate about nuclear power is, at base, a debate about values and ends. Wide-ranging and detailed arguments both for and against the development of nuclear power were subjected to close examination and public scrutiny and it became clear from the proceedings that disputes could not be settled on a purely 'technical' basis (cf. Wynne 1978; Kemp 1980). Moreover, somewhat paradoxically, it may be that the apparent failure of Mr. Justice Parker to appreciate the positions presented by opposition groups has led to a more widespread recognition of the evaluative basis upon which his assessment was made.

Nevertheless, such a recognition would still appear to be largely confined to academic commentators and to certain sections



of the anti-nuclear movement. The argument developed throughout the late 1970s by, for example, Professors David Pearce and Steven Cotgrove, and by Dorothy Nelkin, Peter Taylor and Brian Wynne (see refs. ) to the effect that 'the nuclear debate is about values' has not had much impact at Whitehall or Westminster judging by recent official policy developments. The major statement of official energy policy during the period since 1973/74 was produced in the 1978 Green Paper 'Energy Policy: A Consultative Document' based on the Working Document on Energy Policy produced by the Department of Energy for the first meeting of the Energy Commission in November 1977. The Green Paper took into account the arguments of the Royal Commission in respect of social, environmental and security problems of nuclear fission but presented an optimistic 'technical' response - the appropriate safeguards, institutional changes and technological advances would be forthcoming. There was little recognition of the Commission's point about the fundamental importance of political and ethical dimensions of the issues.

Moreover, the underlying approach to, and philosophy of, policy formulation embodied in the Green Paper was highly rationalistic being based upon a complex, quantitative forecasting methodology which was regarded as investing policy outputs with a high degree of rationality and legitimacy. Traditional objectives for energy policy were restated in broad terms as the achievement of adequate and secure energy supplies to enable the attainment of economic growth targets, the efficient and rational use of such supplies, and the minimisation, as far as practicable, of the resource costs of energy supply and use. Tony Benn, then Minister of Energy, did suggest an alternative formulation of objectives reflecting greater concern for

consumer and environmental interests but there has been little evidence of any significant influence of alternative values and interests on official policy formulation.

To briefly outline the strategy set out in the Green Paper, the rate of economic growth was considered likely to continue to be the main influence on energy demand and two alternative assumptions about future growth formed the basis for 'High' and 'Low' scenarios. The first assumed the continuation of past long-term trends on the basis of a boost to the economy from North Sea oil, producing a growth rate of 3% per annum to the year 2000; the second assumed that growth would fall to an annual rate of less than 2% by the end of the century. Energy demand forecasts were produced from trend projections, reduced by a 'conservation allowance' deriving from price increases and energy saving efforts; this reduction amounted to 20% of primary energy demand in the year 2000. Primary energy consumption was therefore forecast to increase between 1975 and 2000 by 32% to 270 mtoe in the High case. On the supply side the stated aim was to achieve a flexible response within the four fuel context but the strategy outlined included what were seen as 'upper limit' contributions from coal and nuclear power, implying large investment programmes in each of these areas. In the case of nuclear power the strategy involved an installed capacity in 2000 of about 40 TWe implying the commissioning of some 28 new reactors over a period of 21 years. Large contributions were also assumed from North Sea oil (90 million tonnes) and natural gas (35 - 63 billion cubic metres), with imported oil providing the additional supplies needed in the High case. The contribution from renewable sources of energy was assumed to be, at the most, 6 mtoe, that is 2.2% (Low) and 1.8% (High) of total primary energy.

These forecasts were revised in 1979 with the publication by the Department of Energy of 'Energy Projections 1979'. Again, two economic growth assumptions were made but the revisions affected only the composition of GDP and not the rates of growth which remained the same as in the 1978 Green Paper in spite of the poor economic performance actually recorded between 1975 and 1979, the first few years of the forecasting period. The principle adjustment made was to the demand for electricity which was revised substantially downwards in the light of the reduced importance of manufacturing industry in the new GDP forecasts. The new primary energy demand forecasts, again assuming 20% conservation, were 266 mtoe (Low) and 306 (High) for the year 2000. Forecasts were also made for 1990 of 246 mtoe (Low) and 261 mtoe (High). On the supply side the contributions in 2000 of indigenous coal and oil were reduced but that of nuclear power remained at the level of about 55 mtoe, an increase of a factor of seven from the situation in 1979/80. The reason given for the maintenance of this high level of nuclear contribution was the relative cheapness of nuclear electricity compared with that generated from coal-fired plant, and the growth of alternative markets for coal (e.g. liquefaction). These revised forecasts made no explicit provision for a contribution for renewable energy but an allowance was made for 1.5 mtoe of combined heat and power by 2000 based on power station heat.

In 1978/79 there were further substantial increases in the price of oil and the economic recession began to worsen once again. During 1979 a new Conservative Government took office committed to monetarist economic policies and during 1980-82 there was a severe contraction in industrial activity and a consequent sharp fall in energy consumption. Between 1979 and 1982 energy consumption declined by 12% overall and

by no less than 25% in the industrial sector. Initially, the Conservative Administration made no fundamental changes in policy direction, endorsing the 1979 Energy Projections and the need to pursue a 'flexible strategy' to maintain all options with a longer term emphasis on three major components: conservation, coal and nuclear power. Traditional energy policy objectives have been restated: to ensure adequate and secure supplies of energy and its efficient use at the lowest practicable cost to the nation. However, more recent statements of energy policy indicate a shift of focus, within the context of the wider approach taken to economic policy, towards a laissez-faire perspective with the emphasis on creating the conditions in which energy markets can operate as nearly as possible as free markets. Consequently, the major appropriate instruments of policy are now seen as the stimulus of competitiveness and efficiency in the supply industries and the pricing of energy to reflect market pressures or long-run costs; efficiency can then be achieved in relation to rational decisions by consumers left to respond to market signals.

Official projections of future energy demand and supply possibilities, providing a framework for policy considerations, were updated in 1982 to take account of major changes since 1979 in economic growth prospects, the world oil market and the structure of the British economy. The considerable uncertainty engendered by these changes promoted the development of a wide range of future scenarios developed from combinations of assumptions relating to economic growth, fossil fuel prices and industrial structure. Covering the period 1980-2000 the GDP growth assumptions ranged from 2½% p.a. (High) through 1½% p.a. (Medium) to ½% p.a. (Low) and these were combined with high and low fossil fuel price assumptions and high and low growth rates for major energy-using industries. The resulting primary energy

demand forecasts for the year 2000 ranged from a highest value of 277 mtoe to a lowest of 197 mtoe, respectively 9% and 26% down from the High and Low projections of 1979.

On the supply side, coal and oil each supply about one-third of energy consumption in 2000 in most scenarios, natural gas around 18%, nuclear 11 - 16% and renewable sources about 1%. The contribution of nuclear power is therefore reduced from the 1979 Projections, with a maximum of 44 mtoe in 2000 (compared with 57 mtoe), involving a commissioning rate between 1991 and 2000 of 2.1 GW per year. Notwithstanding a slow-down in the rate of growth in electricity demand (0.5 - 3.1% p.a. between 1990 and 2000) the government regards nuclear power as having the potential to produce electricity more cheaply than fossil fuels and therefore sees its energy objectives as best promoted by a substantial commissioning of nuclear plant. The projections include a possible CHP scheme of 200 MW capacity by 1990 building up to a maximum 2 GW by 2010. Renewable energy sources are projected to contribute a maximum of 3% to power station fuelling by 2010; the Severn Barrage is excluded from the projections but is seen as potentially saving up to 4% of power station fuelling and 1 GW in the need for generating capacity.

Within this framework, then, recent government energy policy has consisted mainly in measures such as the Energy Act 1983 (HMSO 1983) to increase competition in the energy sector, to increase efficiency in public sector energy industries and to promote 'economic' pricing of fuels. Conservation policy relies primarily on pricing to ensure that appropriate economic signals are sent to energy consumers although this is supplemented by a programme of information and

advice and grant aid for insulation. The approach to public sector supply industries is illustrated by, for example, the Coal Industry Act of 1980 which was passed with the intention of making the coal industry profitable by 1983-84; operating grants were to be phased out so that coal production would be increasingly concentrated on newer, more productive mines, and uneconomic pits would be closed. The Act also provided continued support for the NCB's ten-year investment programme and an extension of borrowing limits. As regards the gas industry, measures are being introduced to sell off certain assets to the private sector while the 1983 Energy Act (ibid.) facilitates private generation in the electricity sector.

Government policy in respect of nuclear power has attracted considerable attention over the past few years. After taking office, the Conservative Administration soon set out a framework for the long-term development of nuclear power. In a Commons statement in December 1979 the Energy Secretary stated that over the decade from 1982 a programme of the order of 15 GWe of new nuclear capacity should be considered as 'a reasonable prospect against which the nuclear and power plant industries could plan'. This was in addition to the two AGRs at Torness and Heysham agreed to by the previous Government in 1978. Such a programme would bring the total installed capacity in 2000 to about 22 GWe (assuming the decommissioning of all the existing Magnox stations) compared with the 40 GWe implied in the 1979 Energy Projections.

Moreover, the Government proposed that the next nuclear order should be for a pressurized water reactor in order to establish an alternative reactor to the AGR and that construction should commence in 1982

subject to the findings of a public inquiry. In January 1981 the CEGB applied to the Secretary of State for consent to construct a 1200 MW PWR at Sizewell but the public inquiry into the CEGB's proposals was delayed until January 1983 and is likely to continue well into 1984 thus frustrating the nuclear industry's hopes of an early start to a programme of PWR construction. As indicated earlier, the Government's latest energy projections, presented at the Sizewell Inquiry, present a range of assumptions about new nuclear capacity between 1991 - 2000 from a low value of 5 GW to a highest of 21 GW. Compared with a total nuclear capacity in 1990 of 11 GW (contributing between 25% - 31% of power station fuelling) the projected capacity in 2000 ranges from 13 GW (32% of power station fuelling) to 29 GW (providing 40% of power station fuelling). It is notable that the 'medium case' projections imply a rate of commissioning between 1991 and 2000 (1.5 GW p.a.) and a total nuclear capacity in 2000 (c. 22 GW) which are compatible with the 'framework' adopted in 1979.

The Government's position on nuclear power has come in for considerable criticism in recent years. The House of Commons Select Committee on Energy presented a report in 1981 which was critical of several aspects of the case put forward by the Government and the CEGB for investment of £15 billion in new nuclear capacity. Pointing to the substantial over-capacity in the CEGB and SSEB systems the Committee questioned assumptions about economic growth, fuel and capital costs and criticised the Department of Energy's approach to energy conservation, arguing that investment in new nuclear generating capacity should be evaluated against a comparable investment in conservation. In its reply to the Select Committee, published in a White Paper in July 1981, the Government rejected the criticism that

the level of ordering of nuclear plant envisaged in the 1979 statement is excessive although it emphasised that each new station would be evaluated on its merits " ... taking into account the need for full diversity, the economic assessment of the generation costs of different fuels, the development of electricity demand, the performance of the industry, and the extent to which extensions to plant life can be regarded as feasible and economic".

More recently, Government policy has been subjected to criticism by several bodies appearing as objectors at the Sizewell Public Inquiry, the terms of reference of which have permitted a very wide-ranging scrutiny of energy policy. Organisations such as the Council for the Protection of Rural England, the Town and Country Planning Association and the Friends of the Earth are presenting cases against the proposal and cross-examining Department of Energy and CEBG witnesses in an inquiry which certainly represents the most significant event in the nuclear power debate to date. However, the extent to which the criticisms will influence government policy must be open to question in view of the Energy Secretary's reported reference to objectors as 'conspiracy theorists and special pleaders' who ignore the merits of the Government's position and his presentation of the case for nuclear power as 'unassailable' (Guardian 12/5/83).

Finally on official energy policy, optimism about the future role of nuclear power contrasts with a view of the potential contribution of renewable energy sources which is even more pessimistic than that of the previous Labour Government. In the 1982 Energy Projections biofuels and renewables contribute only 1% of primary energy demand (for energy uses) in 2000, a maximum of about 3 mtoe. By 2010 the



maximum contribution increases to 12 mtoe representing 4% of primary energy demand. However, some progress has been made in recent years in R & D programmes, particularly with wind energy. For example, in January 1981 the Government announced plans for building a full-scale aerogenerator of 3 MW capacity in the Orkneys by the Department of Energy and the North of Scotland Hydro-Electric Board to assess reliability and economics under severe weather conditions; this is now under construction. The CEGB has constructed a 200 kw wind turbine at Carmarthen Bay as a forerunner of a larger 5 MW machine which the Board plans to build and test at Ramsgate in Kent. In the longer term the CEGB plans to develop a 'farm' of about ten aerogenerators by about 1990 to assess both operational performance and environmental acceptability. A Government Committee (the Bondi Committee) reported in 1981 on the potential for a tidal barrage on the Severn Estuary producing about 13 TWh p.a., arguing that such a barrier would be technically feasible and an economic investment in many scenarios, and recommending further studies on environmental and industrial impacts, economic factors and preliminary design. The Government is considering this report.

Geothermal energy experiments are under way at Marchwood near Southampton and at the Cambourne School of Mines in Cornwall, the latter with funding from the Department of Energy and the EEC. Government spending on R & D in the area of alternative energy sources has been increased to a level of about £14 million p.a. but the Advisory Council on Research and Development (ACORD) recently recommended to the Government that new expenditure on research and development into renewable energy should be severely restricted (Department of Energy 1982B). Apart from some research into

geothermal energy and passive solar building design, ACORD argued that further work beyond existing programmes should not proceed; therefore, the programme of research into wave energy, for example, has been severely curtailed. However, studies are progressing on CHP/DH. In 1980 the Government reacted to the Marshall Report by appointing consultants to undertake an analysis of potential candidates for 'lead cities' and a detailed study of nine such candidates has been completed indicating that CHP/DH is feasible in all cases although the economic case is best for larger urban areas (e.g. London, Manchester and Tyneside). The 1983 Energy Act made it incumbent upon Electricity Boards to adopt and support CHP schemes and to make use of by-product heat from electricity generation (House of Commons 1983 Section 19).

It is apparent, then, that the concern to proceed with a substantial programme of development of nuclear power is an important element in official energy policy at the present time. In such a context little sympathy is being given in government and nuclear industry circles to arguments about the political and ethical dimensions of the issues involved, and the importance of analysing the value-stances which underlie the controversy. Nevertheless, the Sizewell Public Inquiry has served to provide an impetus to such arguments as did the Windscale Inquiry in 1977. The issues involved in the debate about nuclear power are clearly of considerable moment in the context of discussions about social and technological futures and so it is important to attempt to obtain a better understanding of the role played by evaluative considerations in the debate.

### 1.5 'Values' and the Nuclear Power Debate

As indicated earlier, various academic commentators have been arguing in recent years that the debate about nuclear power is more about what the technology 'stands for' in wider social terms than about its 'technical aspects'. The arguments to this effect presented by Professor David Pearce have been influential. His analysis, with others, of the Windscale Inquiry (Pearce et al. 1979) first elaborated an argument which he subsequently developed elsewhere:

"(The nuclear debate) ... is about the public image of the nuclear industry. It is about the fear that 'experts' are imposing a technology on an unwary public, who increasingly find the pace of technological change beyond their control, beyond the means that ordinary citizens and pressure groups have for calling a halt while the matter is aired in the open. It is about the issue of 'need': whether the demand for electricity justifies more and expensive nuclear power stations. It is about bigness and centralisation of control. It is, in short, a debate about life-style and the direction in which we, as a society, want to go."  
(Pearce 1981 p. 23)

Again, Bickerstaffe and Pearce (1980) argue, in greater detail, that the concept of nuclear power as a symbol of centralized and large-scale bureaucracies, distant from consumer control, is common to much opposition to technological change. Argument centres not on the costs and benefits of nuclear power per se but on the value systems relevant to the image of society typified by significant nuclear programmes. This image is of materialist, 'post-industrial' society; yet many people desire a 'post-materialist, post-industrial' society (ibid. p. 312-3):

"Where value systems differ, however, argument about the features of nuclear technology, its safety, its economic record, and so on, become essentially irrelevant. There can be no reasoned convergence of value systems."  
(ibid p. 313).

This position has also been developed by Professor Stephen Cotgrove within the context of his study of 'environmentalism' (Cotgrove 1981, 1982; Cotgrove and Duff 1980). He argues that:

"... the debate between environmentalists and their opponents over, for example, nuclear power, is more than simply an

argument about the effects of low-level radiation, or the probabilities of accidents. It is also a debate about the values which can justify nuclear risks." (op. cit. 1981 p. 124)

More specifically:

"... the opposition of nuclear protestors goes beyond technical questions of risk and safety and economic benefits. It is the wider questions of social, political and psychological risk to which they attach importance. The significance and meaning of nuclear power for the social and moral order of the opponents is the promise of remote impersonal centralised bureaucracies, increased reliance on experts, loss of control over decisions which affect their lives, threats to personal liberty from the security requirements of the plutonium economy, as well as the risks of nuclear proliferation. To the supporters, it is the economic benefits which are of overriding importance. Their social and moral order is threatened by the failure to develop nuclear power. If the environment takes a knock or two or if society takes some calculated risks, then this is the price to be paid for the pursuit of the greater good." (ibid. p. 133).

This argument implies, therefore, that progress towards the resolution of conflict over such issues as nuclear power, towards the achievement of greater consensus, towards the defusing of frustrated, potentially violent opposition - such progress is contingent upon a recognition of the political dimensions of the controversy and the establishment of procedures for public discussion and decision-making which can incorporate the consideration of opposing 'social paradigms' (cf. Cotgrove and Duff op. cit.; Pearce 1978). Bickerstaffe and Pearce (op. cit. p. 333) argue that to the extent that consensus depends upon a unity of values then there is little prospect that it can be achieved in view of deep disagreements over social goals which underlie the nuclear debate. However, they suggest that progress towards greater consensus can be achieved through efforts to

" ... give 'fair hearing' to all parties in the debate, and to separate out issues of political choice in defining goals from those of technological means, giving each explicit recognition (ibid. p. 336).

Other recent work which has emphasised the evaluative dimension of the nuclear debate can be briefly referred to. Del Sesto (1980) analyses the nuclear debate, as manifested in the US Congressional hearings on reactor safety in 1973/74, in relation to ...

' ... ideological cleavages and differences in the world view of the partisans involved.' (ibid. p. 40). He is concerned to show, then, that the debate goes beyond technical issues into sociopolitical, moral and ethical dimensions in which ideological conflicts are of fundamental importance. Stott (1981) also emphasises the ideological bases of the debate, arguing that the faith of so many Western governments in nuclear power must be interpreted in relation to " ... the ideological bases common to advanced industrial nations and the assumptions underlying them" (ibid. p. 106). Conversely, he argues that opposition to nuclear power goes beyond technical issues of safety and economy and arises " ... because it represents the development of certain directions in society, technocratic non-participating, centralist." (ibid.).

These approaches to the analysis of the nuclear power debate, then, have presented a serious challenge to the traditional technical or 'engineering' conception of the issues (cf. Lovins 1975 p. 12-14). However, they also generate a conceptual problem concerning the relationship between the 'technical' and 'ideological' realms in public policy disputes. There has been little explicit consideration

of this relationship and, indeed, a tendency to implicitly assume the separability of these two realms, implying that the recognition of the importance of ideological factors in the debate does not necessarily prejudice the discussion of scientific facts in the 'technical' realm. For example, the position represented by Pearce, discussed above, tends to retain the dichotomous distinction between means and ends, between the 'technical' and the 'political', between facts and values. While this position acknowledges the importance of dispute over political and social ends and values and the inability of discussions of technical means and the 'facts' to settle the dispute, it is nevertheless maintained that if we carefully identify and separate out evaluative issues and considerations then the rationality of decision-making processes can be increased with respect to technical discussions of the costs and benefits of means based on the findings of science (cf. Bickerstaffe and Pearce op. cit.). Dorothy Nelkin also argues that...

"... increased knowledge may eventually depoliticize an issue by helping to separate facts from values or by clarifying the technical constraints that limit policy choices."  
(Nelkin 1979A p. 19)

From such a perspective, then, the problem essentially arises from the process of evaluating costs and benefits of nuclear power in relation to broader social, political and ethical aims, values and aspirations since different groups will weight different costs and benefits in different ways and, indeed, while agreeing on the existence of a particular impact, may disagree about whether it constitutes a 'cost' or a 'benefit'. The resulting implication for the policy-making process is that such dispute about social ends and values should be recognised as legitimate and important and institutional reforms should

be implemented to permit its accommodation and resolution according to democratic principles (cf. Pearce 1978; Pearce et al. 1979).

However, it can be argued that such a perspective places excessive confidence on the degree to which social scientists can produce knowledge about the costs and benefits of nuclear power which can be considered value-free and 'cognitively reliable'. Recent work in the fields of the philosophy, sociology and history of science has indicated that scientific knowledge of social phenomena is conditioned by social interests and values to an extent and in such a way as to prejudice all conceptions relying on the separability of facts and values irrespective of whether or not considerations relating to the latter are seen as 'relevant', 'important' and 'rational'. Against this background my basic concern in this thesis is to provide an analysis of the nature of scientific knowledge of social phenomena in our society and its role and influence in debate about issues of social and technological development using the debate about nuclear power as an example. The broad perspective adopted involves an emphasis upon the relationship between scientific activity and wider social and political processes.

Brian Wynne (1982) has recently published an analysis of the role of scientific rationality in decision-making processes, based on the Windscale Inquiry in particular, which adopts a similar perspective. In this important, seminal work, Wynne is basically concerned with the role of cognitive structures in providing institutionalised authority to legitimise technological commitments. He criticises the models of rationality in decision-making which rely on conceptions of value-free science and supports a conception of scientific knowledge

as evolving within 'intellectual-emotional complexes' or 'cosmologies' and developed in interpretive fashion in relation to the social interests and experiences of different groups. Scientific knowledge, he argues, plays an important role in achieving authority and political control and is reinforced (or, indeed, supplanted) in this role by a 'judicial ideology' which attempts to reduce debates about technological development to 'concrete technical facts' of unambiguous meaning, thus concealing the social relations of decision-making. He applies this conceptual framework in an analysis of the Windscale Inquiry concluding that knowledge plays a complex moral and political role which is neglected, indeed concealed, in traditional conceptions.

The analyses in this thesis, then, are concerned with similar issues to those examined by Wynne although the detailed approach and focus is rather different\*. In the first part of the thesis (chapters 2 - 6) my aim is to develop a conception of the nature of social scientific knowledge as it is constituted in our society and of its role in relation to the 'societal guidance' activities of the modern State. In the second part (chapters 7 - 9) I review the major controversies in the debate about nuclear power development and examine certain aspects of this debate in order to elaborate upon some of the implications of this conceptual framework.

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\* The analyses reported here were complete and the thesis substantially written before I read Wynne's work and consequently it is not referenced in subsequent chapters.



## Chapter 2: Rationality in Scientific Knowledge

### 2.1 Introduction

The purpose of this chapter is to review the arguments which have been developed by philosophers of science concerning the possibility of achieving rational scientific knowledge of any kind. After setting the broad context in a brief review of the historical development of conceptions of science and its role in society, I discuss current controversies over the rationality of science. In this discussion I outline what I perceive to be an 'orthodox' conception of science and then consider criticisms of this conception which arise from different positions within the philosophy of science. The critiques considered are those of the realist and conventionalist positions, that which arises from the view of science as an essentially problem-solving activity, and, finally, that of the so-called critical theorists who see science as an ideology underlain by the purpose of technical control over nature and society.

## 2.2. Historical Perspective

The idea that the possession of knowledge is essential to the advancement of civilization, dates back to the writings of the Greek philosophers who were concerned with the problem of achieving and maintaining political order through the selection of knowledgeable rulers and the establishment of virtuous conduct amongst the citizens (Rich 1979 p 6-7; McCarthy 1978 p 2). Thus, Plato's emphasis was on salvation through government by a knowledgeable ruler; political action could justly only be decided by the 'philosopher King' because only such adequately educated persons were in possession of true knowledge of 'Forms'. Such knowledge was obtained by going beyond perception in the world of appearances via reasoning from premises to conclusions, to 'seeing' connections between real things so as to grasp the 'Form' of things, where such 'Forms' are metaphysical entities (eg Truth) (Kerr 1981 p 485-6; Rich op.cit.). Therefore, from Plato we obtain the notion that only theoretical knowledge of true propositions can intelligently direct practical action and that the main problem of government was to join power and knowledge and develop a science of politics grounded in theoretical knowledge but designed for the transformation and control of society (Gunnell 1976 p 32).

A fundamental characteristic of the Platonic conception of knowledge is its recognition of the distinction between surface, contingent appearances and an underlying reality and its equation of Truth with knowledge of the latter. Also in this unified conception of knowledge there was no radical distinction between science and political values (cf. Marcuse 1964 Ch.5). However, Plato's pupil Aristotle, in his system of logic, saw theoretical knowledge as concerned with the development of general laws in relation to an object of knowledge which

was given by experience and expressed in symbolic form. Consequently, science became radically separated from ethics and values which were seen as the subject of an irrational metaphysics. And the focus of science became the given, experienced world; the Platonic conception of the real intelligible world was lost (ibid. Ch. 5-6; McCarthy op.cit). In Aristotelian logic, therefore, lies the origins of modern idealist philosophy with its emphasis on the formal treatment of an artefactual object of knowledge, seen as the product of human cognition rather than as an objective substance with a real existence independent of the mind.

This tradition was developed in Thomas Aquinas' conception of knowledge based on sensations and experiences and developed via generalization and reasoning from those experiences (Kerr op.cit. p 487). Later this tradition provided the basis for the intellectual revolution of the seventeenth century in which science came to be seen as a distinctive category of inquiry and, as such, as a means to challenge and overcome traditional beliefs and modes of thinking. Specifically, science, as conceived by Francis Bacon in particular, was presented as involving a new emphasis on rigorous method and critical thought in pursuit of truth, as a means of overcoming arbitrary bias and human error, as a branch of knowledge totally separate from religion and ethics, and as a means to challenge the accepted synonymy of knowledge and religious faith which was seen as supporting a dogmatic system of metaphysics implying a rational order of things, buttressed by powerful institutions (Rich op.cit. p 7-9).

The subsequent development of science in the eighteenth and nineteenth centuries was characterised by two primary orientations. Firstly, the idealist conception of knowledge was consolidated, for example in Hume's work. Thus, Hume saw scientific knowledge as involving the

development of causal ('conjoining') statements on the basis of observation of events in time and space. He therefore emphasized the view that the use of 'a priori' reasoning to arrive at claims about matters of fact or existence creates nonsense or meaningless talk; the Platonic 'grasping' of the connections between 'real' entities to produce a knowledge of 'Forms' was considered as meaningless, beyond the realm of human understanding. Science, firmly based in observation and experience, was radically distinguished from metaphysics (Kerr op. cit. p. 489).

The second orientation derived from Bacon's emphasis, reminiscent of Plato, on scientific knowledge as the basis of power. Although by no means a unanimous preoccupation amongst scientific philosophers and social theorists, there has been an important tendency since the philosophical upheaval in the seventeenth century which has emphasized the usefulness of science to the state and to society in general (Dreitzel 1972 p. 166; Rich op.cit. p. 9-10). The Baconian motivation - 'Scientia Ex Potentia Humanum In Idem Coincident' - was subsequently developed by Condorcet, Saint-Simon and Comte, all of whom saw science, on the one hand, as the only source of true knowledge, opposed to superstition and dogma, and, on the other, as essential to 'progress' and the advancement of civilization (ibid.)

These two orientations - observability and applicability - were essentially interrelated in that the latter, the usefulness of science in directing human progress, was dependent upon the ability of science to reveal the truth about the world (seen as its distinctive characteristic) and this ability was seen to rest upon the development of scientific laws on the basis of observable phenomena. Moreover, the idealist conception of the object of knowledge as the creation of the

human mind can be seen as fostering an orientation towards the control and modification of that object. Thus, McCarthy argues :

"Although the pursuit of science for its own sake (that is, in order to comprehend the true order of nature) was historically at least as important as the Baconian motivation, 'scientia propter potentiam', a potential for predictive and technological application is intrinsic to theoretical knowledge of this sort. Given a description of the relevant initial conditions, scientific laws can be used (within certain limits) to predict future states of a system. Providing that the relevant factors are manipulable, these laws can also be used to produce a desired state of affairs." (McCarthy op.cit. p. 3).

More recent developments in science can be seen as having consolidated and extended these historical tendencies. Thus, the positivist tendencies deriving from Comte were developed and systematized in 'Logical Positivism' (or 'analytical philosophy') which was developed in the 'Vienna Circle' and in Reichenbach's Berlin School in the 1920s with the aim of establishing definitive frontiers between science and metaphysics and of elevating the empiricist tradition of European philosophy into a scientific philosophy which would, once and for all, fix the principles and methods of science in a system of norms (Suppe 1974 p. 7-11; Wellmar 1974 p. 16; Los 1977 p. 10). This was made possible by developments in mathematical logic culminating in Whitehead and Russell's 'Principia Mathematica'; thus 'empiricism' and 'logicism' were conjoined so that mathematical statements of scientific laws and definitions of theoretical terms could be produced in terms of mathematical logic with the aim "... to reach the unification of scientific knowledge and to find a method common to all science, which can provide guarantees against the accumulation of meaningless concepts or pseudo-problems." (Los op.cit. p. 11).

Another important trend has been the increasing interrelationship

between science and technology and the increasing role of government in this relationship. This shift in emphasis between pure and applied science reflects the developing concern with the application of science to human advancement and progress in a context where such 'progress' is defined primarily in relation to the economic and industrial system. And the view, strengthened by World War II, of applied science and technology as basic means of production in the modern industrial system, promoted the increasing role of government in influencing the kind of research carried out, its application to technological developments and in directly supporting such developments. Such is the strength of the institutionalized connection between science and technology that "... today technological considerations play a dominant role in determining the direction of progress in many areas of pure science." (McCarthy op. cit. p. 3). In view, therefore, of the extent to which science has become intimately connected to the practical spheres of social and technological development it can be argued that there is a consequent requirement for a philosophical justification of this role which simultaneously emphasizes the practical power of scientific knowledge while grounding this power in the 'objective' nature of that knowledge. Positivist philosophy provides this justification in a view of knowledge guaranteed freedom from the tainting intrusion of normative considerations by a unitary methodology which permits progress towards Truth, and thereby provides the warrant for the use of such knowledge to guide human affairs.

## 2.3. Controversies over the Rationality of Scientific Knowledge

### 2.3.1 An Orthodox Position

In view of the essentially controversial nature of the philosophy of science it is difficult to define an 'orthodox' position. However, as indicated in the previous section, the development of Western Science has been underlain by the conviction that its rationality resides primarily in a guarantee of true, progressive or, at least, highly confirmed knowledge. Despite the fact that this conviction has been shaken in recent times by sceptical challenges based, for example, on historical studies of actual scientific activity, the predominant response to such challenges has been to refine traditional approaches and to reassert the cognitive well-foundedness of science as its rational basis (Laudan 1977 p. 1-4). Within this general tradition it is possible to suggest that there exists a broadly orthodox view of science as involving the explanation of the world through the development of universal laws of nature whose degree of truthfulness can be established with reference to empirical observations.

Now, classical Humean empiricism holds that the objects of knowledge are atomistic events which constitute given facts and that such facts provide a secure basis for scientific knowledge; empirical regularities or constant conjunctions of events developed on this basis are both necessary and sufficient for scientific knowledge (Bhaskar 1975 p. 24, 127). Post-Humean idealist philosophy has, however, developed the conception of the objects of knowledge as artificial constructs which are the product of human cognition viz. subjective experiences of an observational character. Such experiential constructs are still nevertheless asserted to provide a secure basis for scientific knowledge but now the constant conjunction of events is an insufficient though still necessary condition for science (ibid p. 25; Popper 1979 p. 35-6).

Consequently, the orthodox model of scientific rationality is founded upon the Humean view of causality which defines laws in terms of regular successions of events or states of affairs, repeatedly observed: viz. an event A is caused by another event B when B is temporally prior to A; and whenever an event of type B occurs it is always followed by one of type A (Bhaskar op. cit. p. 127-9; Keat and Urry 1975 p. 12, 28-9; Lessnoff 1974 p. 23-4). The primary aim of science is therefore seen as the development of 'satisfactory explanations' of events by the discovery and statement of laws of nature with the status of universal empirical statements of temporal correlation under which those events can be subsumed (Popper op.cit. p. 191-2; Bhaskar op.cit. p. 129-30; Lessnoff op. cit. p. 11; Ryan 1970 p. 46). The dominant model of scientific explanation, following the work of Hempel, Nagel, Oppenheim and Popper, is the 'deductive-nomological' structure:

"By an 'explanation' (or a causal explanation) is meant a set of statements by which one describes the state of affairs to be explained (the 'explicandum') while the others, the explanatory statements form the 'explanation' in the narrower sense of the word (the 'explicans' of the 'explicandum').". (Popper op.cit. p. 191).

More precisely, deductive explanation requires a logical argument comprising three parts (Keat and Urry op. cit. p. 10; Ryan op. cit. p. 49; Rudner 1966 p. 60):

- i A statement describing the event to be explained (ie the 'explicandum' or 'explanandum');
- ii A set of statements describing the relevant circumstances that are antecedent to, or otherwise causally related to, the explicandum (ie 'initial conditions' or 'causal antecedents');



- iii A set of lawlike statements to the effect that the initial conditions, when present, will cause the explicandum to occur.

The latter two parts of the argument comprise the 'explicans' (or 'explanans'), and to be satisfactory they must fulfill certain conditions (Popper op.cit. p. 192-3; Bhaskar op.cit. p. 130).

- a. The 'explicans' must logically entail the 'explicandum' ie the latter should be deducible from the former;
- b. The 'explicans' ought to be true, or at least well-corroborated or not known to be false after critical examination;
- c. If not known to be true the 'explicans' must be independently testable (ie the 'explicandum' must not provide the only evidence for the 'explicans');
- d. The 'explicans' must contain at least one universal law.

According to this model the statements of universal laws together with their initial conditions provide a basis for either explanation or prediction of events and an argument enabling prediction also permits explanation. The difference lies merely in the fact that the 'explicandum' of an explanation lies in the past while that of a prediction lies in the future (Bhaskar op.cit.; Keat and Urry op.cit. p.11-12).

One of the central problems of the philosophy of science has concerned the above conditions for satisfactory 'explicans', in particular the question of corroboration of the universal laws. The fundamental principle of the orthodox view is that laws, with the status of universal empirical hypotheses, are tested in relation to their instances which constitute the objects of actual or possible observable experiences (Bhaskar op.cit. p. 131). The traditional justificationalist answer to the problem involved the view that such hypotheses should be confirmed or proven as true, or at least highly probable, on a self-justifying foundation either of 'infallible reason' or 'intuition' (the intellectualist or rationalist response) or, more commonly, of experience (the empiricist response) (Lakatos 1970 p. 93-4; Briskman 1977 p. 511-2). The empiricist justificationalist argument rests on two fundamental assumptions:

- a. The positivist assumption that all cognitively meaningful statements are of just two exclusive kinds. Analytic statements are statements of language, whose truth arises from the meanings of their terms, and which make no empirical assertions about the world (ie have no factual content). Synthetic statements are statements of fact and therefore contain all knowledge about the world; their truth must be established by induction and they can therefore be corroborated, unlike analytic statements (Hollis and Nell 1975 p. 5-7; Hindess 1977 p. 17-18). The positivist view considers the latter synthetic observation statements to be 'ontologically privileged', in that only such statements can make genuine reference to items in the real world. Moreover, they are also considered to be 'epistemologically privileged' in two senses: firstly, in that the truth value of statements

containing only observational terms can be known with greater certainty than those (ie analytic statements) containing only theoretical terms; and, secondly, in that the truth value of observation statements can be established without reference to that of analytic theoretical statements ie empirical knowledge is theory-neutral (Keat and Urry op.cit. p. 18-20; Hesse 1976 p. 4). Consequently, the empiricist justificationalist must assume the existence and availability of true, theory-neutral observation statements.

- b. The second necessary assumption is that it is possible to reason by induction to establish the truth of empirical hypotheses on the basis of 'given' observation statements. (Popper op.cit. Lakatos op.cit.).

The untenability of these assumptions is now widely accepted and consequently justificationalism has been undermined. Firstly, the possibility of an a-theoretical observation language cannot be demonstrated. Thus, in order to test an observation language in relation to reality we must 'stand outside' that language; but this requires reference to another observation language with respect to which the same problem must arise. Since we cannot, by definition, 'stand outside' all possible observation language an infinite regress opens up. Therefore, positivism cannot demonstrate the possibility of an a-theoretical observation language; it merely asserts this assumption and this constitutes dogma in its own terms (Hindess op.cit. p.139-40). More generally any justificationalist foundation is open to demands for justification and therefore the problem of infinite regress (Briskman

op.cit. p. 512). In fact it is now widely believed that observations cannot be made independently of theory-based expectations; to quote Popper,...

"...there is nothing direct or immediate in our experience: we have to learn ...It is all decoding, or interpretation." (op.cit. p.35-6).

"...there is no observation which is not related to a set of typical situations-regularities-between which it tries to find a decision...there is no sense organ in which anticipatory theories are not genetically incorporated". (ibid. p. 72).

The general problem, then, is that if observation cannot be independent of theory, how can the test of a theory with respect to such observation be decisive ?

Secondly, a problem which has preoccupied philosophers of science for centuries is that no matter how many repeatedly similar and constant observations we may make of some phenomenon, these observations can never prove the truth of a theory developed from them; there is always the possibility that the next observation will contradict the theory. This result is independent of the truth of observation statements; thus, in Popper's formulation of the logical problem no number of true test statements would justify the claim that an explanatory universal theory is true (Popper op.cit. p. 7).

With the collapse of justificationalism the banner of rationality in science has passed to Popper's falsificationism which represents a considerable liberalization of positivism, while still remaining committed to truth as a regulative concept (ibid p. 29) and to the

demarcation of science from 'pseudo-science' (ie rather than metaphysics cf. Popper 1976). Popper's proposed solution to the problems of justificationalism remains tied to the principle that theories are tested in relation to empirical evidence, but in order to overcome the problem of induction he argues that the rational method of science consists in a constant effort to falsify empirical hypotheses by the construction of severe crucial tests.

Firstly, in relation to psychological aspects of his theory, Popper, as indicated above, rejects the view that we begin with pure empirical observations and then derive a theory to explain them; rather he insists that we necessarily make observations in the light of prior theory or expectations - "...conjecture or hypothesis must come before observation or perception..." (ibid p. 52). The two consequences of this thesis are, firstly, that since we arrive at theories more by reason than by observation, we must subject those theories to severe tests; and, secondly, that there can be no theory-neutral, basic observation statements against which to test theories.

The problem of testing such theories is, then, the concern of Popper's 'logic of knowledge'. Although, Popper argues, it is logically impossible to confirm the truth of a universal statement (hypothesis or theory) on the basis of any number of singular statements (observational experiences), the latter can be used to logically prove the falsity of a universal statement. He therefore reformulates the problem of induction in terms of the logical asymmetry between universal and singular statements.

"... there is no induction, because universal theories are not deducible from singular statements. But they may be refuted by singular statements, since they may clash with descriptions of observable facts." (ibid p. 86).

Consequently, Popper's proposed theory of the method of science involves two imperatives: firstly, it is necessary to explicitly state preconceived assumptions, hypotheses and theories as empirically testable propositions; and, secondly, we should then submit such propositions to rigorous tests by confronting them with empirical evidence in an attempt to expose their deficiencies:

"The method of science is the method of bold conjectures and ingenious and severe attempts to refute them".  
(Popper 1979 p. 81).

A simple criterion for the demarcation of science from non-science or pseudo-science is therefore provided by Popper's theory. Science proposes empirically testable hypotheses which are open to falsification with respect to empirical evidence and then proceeds to rigorously attempt to falsify them; scientists must be prepared and able to state in advance the evidence which they would accept as falsifying their hypotheses. On the other hand, pseudo-science (Popper singles out Marxism and Freudian psychoanalysis) does not advance falsifiable hypotheses.

The critical method of science, then, involves the elimination of hypotheses which are refuted in crucial tests and the retention of those which survive as scientific theories. However, Popper argues that such theories cannot be seen to be proven as true, only as unfalsified, and therefore to be preferred and provisionally accepted as a basis for action and further continued attempts at falsification (ibid.Ch. 1).

We cannot therefore speak of the 'truth' or 'certainty' of scientific knowledge but by rigorously pursuing the critical method of conjecture and refutation we can have good reason to believe that our accepted scientific theories correspond more closely to the truth than any known alternatives i.e. have higher 'truth content':

"...while we cannot ever have sufficiently good arguments in the empirical sciences for claiming that we have actually reached the truth, we can have strong and reasonably good arguments for claiming that we may have made progress towards the truth". (ibid p. 57-8).

Notwithstanding the argument that objective scientific knowledge is necessarily conjectural, science, for Popper, is the epitome of rationality by virtue of the critical method. A commitment to the continuous, rigorous elimination of errors through criticism and testing can ensure that the 'science of the day' constitutes a better approximation to the truth than any alternatives so far proposed and, further, constitutes the most rational available basis for action:

"...a pragmatic belief in the results of science is not irrational, because there is nothing more 'rational' than the method of critical discussion, which is the method of science. And although it would be irrational to accept any of its results as certain, there is nothing better when it comes to practical action: there is no alternative method which might be said to be more rational". (ibid p. 27).

Now Popper's theory has been widely criticised on the grounds that it does not overcome the problem of theory-dependency of observation. To re-state the problem: if, as Popper himself argues, observations are made in the light of theory-based expectations, and if observational propositions cannot be proven as true (and, therefore, must be taken as fallible) how can contradictions between such propositions and hypotheses or theories result in the conclusive falsification of the

latter? This proposal has some considerable significance to the extent that failure to resolve it presents the danger of the collapse of the attempt to ground the rationality of science in the regulative concept of truth.

Moreover, in practice the situation is even more problematic. Popper's demarcation criterion requires that the scientist be prepared to state the empirical conditions which would constitute grounds for falsification; but most theories will forbid any observable state of affairs only if the influence of other factors is excluded (Lakatos, 1970 p.100-2). Consequently, in a test situation any contradiction which arises will be between a (fallible) observation statement, a theory and a 'ceteris paribus' clause; even if the observation statement were true the contradiction could be blamed on unsatisfied 'ceteris paribus' conditions (ibid; Hollis and Nell, 1975, p.33-8). And there are further complications: for example, it is always possible to 'immunize' a theory against falsification by the introduction of auxiliary hypotheses which make the theory consistent with the evidence in question; a theory may fail a test because of the unsatisfactory performance of test procedures, (Keat and Urry, 1975, p.46-8).

Popper, in fact, recognizes these criticisms and has broadened his position from strict falsificationism to critical rationalism, incorporating falsification as an important special case (cf. Popper, 1976). Imre Lakatos (op.cit.) has argued that in so doing Popper has developed a conventionalist approach. In testing a particular theory the scientist can provisionally decide to accept an observation statement as having 'truth-value'; such decisions are made according to prevailing techniques within the scientific community and are recognized as fallible, being based on background theoretical knowledge



which is accepted as unproblematic within the community as a basis for testing the theory (ibid P.106-8; Hindess, 1977, p.173-4). Moreover, in the event of a contradiction the scientist must again decide what to do in respect of 'acceptance' of 'ceteris paribus' clauses, introduction of auxiliary hypotheses and rejection of the theory under test (Lakatos, op.cit. p.108-10). In effect, such decisions and methodological rules embody a normative conception of what constitutes 'scientific behaviour'; the demarcation criterion between science and 'pseudo-science' essentially refers to a behavioural imperative rather than to the nature of hypotheses and theories (Hindess, op.cit. p.174-5).

Falsification has developed into its most sophisticated form in response to the prospect of a necessary abandonment of the attempt to defend the rationality of science with respect to method, a prospect which appears to loom ahead on the conventionalist path. In this form, tests involve comparisons between alternative series of theories and any such series is falsified only if a new series is proposed which has excess empirical content (some of which is corroborated) and explains the successes of the old series (Lakatos, op.cit. p.116-8). Consequently, falsification involves more than the confrontation between a theory and an empirical basis; rather, it occurs only in the context of competition between theories and must be based upon the emergence of a better theory (or series of theories) (ibid p.119-20). However, even in this form conventionalist decisions are still required, demarcation is essentially a matter of 'intellectual honesty' (cf. the critical attitude), and falsification still relies on corroboration of the empirical content of theories; as Popper (1976, p.104) states:

"...there is no better idea of rationality than that of a readiness to accept criticism; that is, criticism which discusses the merits of competing theories from the point of view of the regulative idea of truth."

Lakatos' development of Popper's position, then, presents the conception of the 'scientific research programme' (SRP), containing a series of theories, as the basic unit of appraisal, (Lakatos op.cit.). The SRP is seen as structured into a 'hard core' and 'protective belt' and as containing rules, standards and conventions in the form of 'negative' and 'positive heuristics'. The 'hard core' comprises basic explanatory laws and metaphysical commitments accepted as irrefutable by the methodological decision of the community of scientists, and protected by the 'negative heuristic' which diverts research (attempts at falsification) towards the 'protective belt'. The latter comprises auxiliary (observational) hypotheses which 'soak up' anomalies, and is constructed in the light of the 'positive heuristic' which provides a plan for the definition of problems, the treatment of anomalies and the further development of the research programme (ibid P.132-6).

Now scientific progress is achieved through the comparative appraisal of research programmes with respect to empirical content and the corroboration of that content with reference to observable states of affairs. Those SRPs displaying 'progressive problem shifts' are to be preferred, i.e. those predicting novel facts backed up 'occasionally' by corroboration. But the decision to abandon a 'degenerating' research programme in favour of a competing 'progressive' programme cannot be clear-cut; Lakatos argues that whereas we may rationally decide not to allow 'refutations' to transmit falsity to the 'hard core' as long as the corroborated empirical content of the 'protective belt' of auxiliary hypotheses increases, we must nevertheless allow for the abandonment of the 'hard core' if the programme ceases to anticipate novel facts (ibid. p.134). Clearly, this is a matter of decision in relation to the standards of the academic community and, like Popper, Lakatos emphasises the critical attitude as the measure of 'intellectual honesty' and, with the idea of empirical corroboration, as the basis

for rationality in science.

The theories propounded by Popper and Lakatos can be seen, then, as representing the most sophisticated attempt to defend the rationality of science in the traditional sense as providing the cognitively best-founded knowledge that we can possibly attain. As argued above, these theories rest upon two fundamental concepts: firstly, that of universal laws based on empirical regularities; and secondly, that of falsification in relation to an empirical basis. A further important feature of these theories is their ontological basis. Thus, underlying the Popperian position is a pluralistic conception of the world:

"In this pluralistic philosophy the world consists of at least three ontologically distinct sub-worlds: or, as I shall say, there are three worlds: the first is the physical world or the world of physical states; the second is the mental world or the world of mental states; and the third is the world of intelligibles, or ideas in the objective sense: or it is the world of possible objects of thought: the world of theories in themselves, and their logical relations; of arguments in themselves; and of problem situations in themselves." (Popper, 1979, p.154).

This ontology, then, is the basis for Popper's conception of objective knowledge - 'knowledge without a knowing subject', i.e. existing independently of the subjective states of mind of any individuals. Scientific knowledge is therefore seen as developing in 'World 3' as a product of human activity but as existing in 'World 3' as an objective structure independent from the human mind (ibid. p.158-9).

The development of this ontological scheme represents an attempt to reconcile the acknowledgment of the subjectivist components in the process of knowledge formation (cf. the psychology of knowledge) with the requirement to ground the defence of the rationality of science

in a conception of 'reliable' knowledge. That this attempt fails is the argument of various critiques; indeed, the defence of the rationality of science presented by the Popper-Lakatos theories has been subjected to criticism from several sources. I shall briefly consider three such positions from the point of view of their criticisms and their alternative conceptions of science.

### 2.3.2 The Realist Critique

Firstly, 'received philosophy of science' is criticized by Bhaskar (1975) from a realist perspective. From such a position the commitment to universal empirical generalizations and empirical testing cannot guarantee rationality; yet the idea of rationality is retained in an alternative conception of science as causal explanation of phenomena in terms of the mechanisms which produce them. Bhaskar's critique centres on the argument that the development of universal law-like statements and the notion that a theory can be tested in relation to its deduced empirical consequences rely on the concept of a closed system in which constant conjunctures of events can be empirically identified (ibid. Chap. 2). However, system closure is only possible under controlled experimental conditions where the system can be assumed to be isolated from external influences or where such influences can be assumed to be constant (viz. 'ceteris paribus'). The restriction of the application of universal laws to such closed systems leaves unanswered the fundamental question of what governs phenomena in the open systems which characterise the real world; but such a restriction is necessary if the universal character and empirical status of the laws is to be retained. Consequently, to the extent that science involves the explanation and identification of causes of phenomena that occur in open systems, it cannot be coherently rationalized in terms of the development of universal empirical laws (ibid.).

Moreover, the restriction of the application of universal laws to

closed systems (i.e. subject to the satisfaction of a 'ceteris paribus' clause) produces the fundamental problem for falsificationism referred to above (p.69 ) viz. that a failure of prediction can always be blamed on unsatisfied 'ceteris paribus' conditions and therefore cannot conclusively refute the law (ibid. p.92-6). Consequently, the idea that a theory can be judged by its deduced empirical consequences and the specification of ex ante criteria for the refutation of a theory only make sense when the system of interest can be closed. Such criteria do not make sense for a science which is concerned to develop causal explanations of phenomena in open system where the subjects, conditions and forms of action are characterised by diversity and constant change, and where consequent events may have a multiplicity of causes and may not be invariably realized. Bhaskar (op.cit. p.104) summarizes as follows:

"Now once we have grasped the ubiquity of open systems in nature we will be in a better position to understand the embarrassment with which textbooks in the philosophy of science gloss over their failure to produce a single law or explanation which satisfy the criteria they so laboriously develop and defend; a fact which bears eloquent witness to the non-availability of universal closures of any epistemic significance. We will also be in a better position to understand not just this failure, but their absurdity, when they seek to apply these same criteria to fields such as history and the human sciences, where the conditions for even a restricted closure (of a non-trivial kind) are not naturally and cannot be experimentally satisfied, and where the concept of action implied by these criteria is patently inapplicable."

Bhaskar, therefore, proposes an alternative 'realist' conception of science which he sees as providing a rational foundation. He argues that scientific explanation should not be analysed as consisting of a form of logical argument enabling prediction of observable events; rather, explanation must penetrate 'behind' constant conjunctures of events to answer the questions how and why those events did or will

occur. To do this it must refer to the mechanisms or structures which generate or produce the phenomena we are trying to explain; we must show how processes of change operate in the world by describing the 'nature' or 'essence' of phenomena.

Consequently, the discovery of empirical regularities is seen as neither a sufficient nor, indeed, a necessary condition of explanation. However, it can constitute a first stage in a dialectic involving the identification of a regularity, the conjecture of a plausible explanation, and the checking of the real entities and processes postulated in the explanation in terms of a description of the generative mechanisms which are actually at work (ibid. Chap. 3). An observed pattern of events might provide a clue to the tendencies of such generative processes but due to the complexity and multiplicity of causation in the world (i.e. in an open-systemic context) such tendencies need not, and often will not, be reflected in an invariant pattern or regularly occurring sequence of events:

"Science must be conceived as an ongoing social activity; and knowledge as a social product which individuals must reproduce or transform, and which individuals must draw upon to use in their own critical explorations of nature. Science is a process in motion, continually on the move from manifest behaviour to essential nature, from the description of things identified at any one level of reality to the construction and testing of possible explanations and thus the discovery of the mechanisms responsible for them. This process necessitates the construction of both new concepts and new tools (or the resurrection or refinement of old ones). The aim of science is the discovery of the mechanisms of the production of phenomena in nature; and it proceeds by way of a dialectic of taxonomic (or descriptive) and explanatory knowledge, in which the conflicting principles of empiricism and rationalism can be reconciled, a dialectic which has no foreseeable end." (ibid. p.248).

### 2.3.3 Conventionalist Critiques - Kuhn and Feyerabend

A second source of criticism for the orthodox conception of scientific rationality centres on the contradiction between the recognition, on the one hand, observation or description is crucially dependent upon theory and training, and the insistence, on the other hand, that rationality resides in the confrontation between theories and observed facts and that theories strive to approximate an adequate conception of an independent reality. Basically, this position argues that if the implications of the theory-dependency of observation are confronted then it is impossible to lay down universal standards for the rationality of science. Rather, science is seen as carried out from within a 'conceptual perspective' or 'world-view' which largely determines which questions are worth investigating and what kinds of answers are acceptable; that is .. "...the perspective provides a way of thinking about a class of phenomena which defines the class of legitimate problems and delimits the standards for their acceptable solution." (Suppe 1974 p.126).

The view that the subject of knowledge is constituted by the community of investigators is indicated in Popper's conception of the 'horizon of expectations' which constitutes what are accepted as facts, but Popper does not pursue the consequences of this view (cf. McCarthy, 1978, p.47-50). The two philosophers perhaps most closely associated with the development of the implications of this line of reasoning are Kuhn and Feyerabend and I will briefly consider their arguments here.

Kuhn's ideas represented a significant challenge to the positivist philosophy of science by questioning the idea of the simple unilinear and cumulative development of scientific knowledge. Significant scientific discoveries, he argued, are not simple 'events' in which a new fact or law is fitted into an evolving edifice of science, but rather arise from complex historical processes and themselves alter



the structure of knowledge through which they are produced (Schuster, 1979, p.303). In his major work (1970) Kuhn conceived of science in terms of two types of period - 'normal' periods which dominate and characterise the scientific endeavour, and 'revolutionary' periods which occasionally produce fundamental upheavals and significant discoveries. In periods of 'normal science' the scientific community works within a 'paradigm' which, as a constellation of beliefs, values, techniques and indeed 'concrete puzzle-solutions' generally held by members of the community, generates a steady supply of 'puzzles' and also the rules for their solution. The paradigm, therefore, constitutes a 'world-view' which determines which facts are significant and ...

"Normal science consists in ... extending the knowledge of those facts that the paradigm displays as particularly revealing, by increasing the extent of the match between those facts and the paradigm's predictions, and by further articulation of the paradigm itself." (Kuhn, 1970, p.24).

Normal science is, therefore, not concerned with the production of major conceptual or phenomenal novelties; rather, it is characterised by extended periods of convergent research, bound by tradition, in which scientists pursue a "... complex and consuming mopping-up operation that consolidates the ground made available by the most recent theoretical breakthrough." (Kuhn, 1977, p.xvii). However, during the course of such consensual activity, anomalies arise - "... an occurrence or set of occurrences that does not fit existing ways of ordering phenomena." (ibid.) - and severe and prolonged discrepancies can produce 'crisis' and a subsequent 'scientific revolution' when the scientific community shifts its allegiances 'en masse' to a new paradigm or world-view which promises to provide the conditions of a new normality, i.e. promises to solve the anomalies which led to the crisis, and to provide a long period of normality (Kuhn, 1970, p.82-92).

Of central importance to Kuhn's account is his notion of the 'paradigm'. Requiring a specification of what the consensus of normal science consists and failing to find the shared explicit definitions of concepts and correspondence rules of orthodox philosophy of science, he conceived of the notion of the paradigm as shared exemplary problem solutions which teach by example the meaning and function of concepts and which serve as models for further 'mopping-up' researches (Schuster, op.cit. p.305-6). The paradigm rules for problem solution were seen as conceptual, theoretical, instrumental and methodological commitments which remain essentially tacit and implicit, not amenable to explicit identification, (Kuhn, 1970, p.43-6). Under pressure of criticism of his original formulation, Kuhn was led to clarify the use of the concept (ibid. p.175-209; Kuhn, 1974, p.463-71). He argues that the term is used in two different senses:

"On the one hand, it stands for the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community. On the other, it denotes one sort of element in that constellation, the concrete puzzle-solutions which, employed as models or examples, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science." (Kuhn, 1970, p.175).

In this elaborated version, then, the paradigm comprises two basic components (Kuhn, 1974, op.cit.):

1. The 'disciplinary matrix' comprising three main elements:
  - (a) Symbolic generalisations: expressions readily cast in logical form;
  - (b) Models: provide the community with preferred analogies, heuristic at one extreme and objects of metaphysical commitment at the other;
  - (c) Exemplars.

2. 'Exemplars' which are concrete problem-solutions accepted by the community as paradigmatic from the study of which, and from attempts to solve problems, the scientist develops 'similarity' or 'resemblance relations' which are used to model the application of symbolic generalizations to new experimental situations.

The disciplinary matrix, therefore, supplies a conceptual framework or 'world-view' and partially determines, or imposes constraints on, what questions may legitimately be asked, what techniques may be employed in seeking solutions, etc., since it provides a language, with meanings specific to the community, for interpreting symbolic generalizations which restricts questions and the way descriptions can be applied to reality. Exemplars are accepted applications of symbolic generalizations to actual problems which replace the correspondence rules of the positivist account (Suppe, 1974, p.483-95).

An important implication of Kuhn's argument is the idea of incommensurability. Each paradigm contains its own interpretation of what constitutes relevant 'facts', problems, standards and methods; "... the differences between successive paradigms are both necessary and irreconcilable." (Kuhn, 1970, p.103). When a scientific revolution produces a change of world-view, interpretations of reality are radically affected; the result is "... an incommensurability of viewpoints, and a partial breakdown of communication between the proponents of different theories." (Kuhn, 1977, p.xii). On this basis Kuhn's argument suggests that rationality can only be defined internally within a paradigm, that universal standards for rationality are impossible and that, consequently, it is not possible to speak of scientific 'progress' in terms of an increasing degree of cognitive well-foundedness. However, Kuhn has, latterly, placed greater emphasis

upon the rational components in his conception. He argues that theory change is rational to the extent that it is guided by certain shared values which have long been emphasised in traditional philosophy of science as objective criteria of internal rationality, viz. accuracy, consistency, congruence with other theories, scope, simplicity and fruitfulness (ibid. p.321-2). And he has rather toned down his views on incommensurability to allow for a certain amount of communication between adherents of different paradigms by a process of translation between the different 'languages' involved (Kuhn, 1970, p.200-2).

However, despite these concessions to traditional views of scientific rationality, and claims of the closeness of his views to Popper's in terms of commitment to predictive and puzzle-solving capability, Kuhn's view nevertheless retains its primary distinctive feature, viz. the necessary reference of scientific practice to its historical and social context. Scientific values are not given and universal rules which determine theory choice but vary between communities, change over time and influence choice in complex ways depending on the selective and interpretive actions of scientists operating in variable and changing social, cultural and historical contexts (Kuhn, 1977, p.324-34). And Kuhn insists that such problems for scientific rationality cannot be dismissed or accommodated by the traditional account in terms of a distinction between the contexts of discovery and justification or, in Popperian terms, between the psychology and logic of knowledge. It is not possible, Kuhn argues, to relegate subjective factors to the context of discovery and to insist on their irrelevance to the question of scientific objectivity; theory choice must be influenced by such personal, social and historical factors (ibid. p.326-9). The position is well summarized by Schuster (op.cit. p.307):

"These contentions ... amount to a radical claim for the thorough going historicity of scientific practice: scientists cannot avoid making judgements which depend upon the skilled interpretation of the current state of play in the light of values, the number, nature and weighting of which are themselves historically evolved, socially maintained and yet in principle always re-negotiable. Scientific knowledge is inextricable from this tissue of judgements and interpretations; in fact they may be identified with it .... But neither does all this render somehow subjective or irrational. One would indeed say that it makes scientific rationality a typically human form of rationality, that is, a species of value-conditioned practical judgement."

This Kuhnian position, then, presents certain fundamental criticisms of the falsificationist conception of scientific rationality; two such criticisms will be briefly outlined (Kuhn, 1977, p.269-88). Firstly, the argument that scientists proceed by testing theories, or systems of theories, against experience by observation and experiment is considered by Kuhn to miss the fundamental distinguishing feature of science. Normal science is concerned with testing hypotheses with current theory premised as the rules of the game - the theory itself cannot be tested. Only in 'extraordinary' research in revolutionary episodes is theory subjected to critical examination and to represent the rationality of science in terms of its occasional revolutionary periods is to distort the actual practice of science; on the contrary normal scientific activity is characterised by the abandonment of critical discourse (ibid. p.269-73).

Secondly, Kuhn adds to the criticism, outlined previously, of the argument that falsification in relation to actual observation and experiment can provide a coherent and rational logic of knowledge. He argues, then, that Popper cannot admit that no conclusive disproof of a theory can ever be produced (due to the possibilities of questioning the experimental results, introducing ad hoc hypotheses, blaming unsatisfied 'ceteris paribus' clause, etc.) and yet still rely on

logical falsification (ibid. p.280-2). Moreover, he suggests that it is not possible to satisfy the necessary requirement of logical falsificationism to classify, firstly, each conceivable event as either a confirming or falsifying instance or as irrelevant to the theory, and, secondly, all logical consequences of the theory into true and false (ibid. p.284-8). Consequently, Kuhn suggests that Popper does not, in fact, provide a separate logic of knowledge which produces objective knowledge in 'world 3'; rather, he provides an ideology - a set of procedural maxims and values or social-psychological imperatives (ibid. p.283).

The critique of orthodox philosophy of science provided by the position developed by Kuhn can be extended by considering the criticisms of Lakatos' conception which derive from it. Schuster (op.cit. p.309-13) develops what he calls a 'neo-Kuhnian' critique of Lakatos by emphasising certain themes in Kuhn's latter work. Firstly, he argues that the definition of what constitutes the hard core, protective belt and negative and positive heuristics, and decisions about progressiveness or degeneracy may be possible with the benefit of hindsight but in scientific practice are open to debate and revision by the relevant community in the course of research. Moreover, the fact that research in any field proceeds along multiple fronts in a non-unilinear fashion aggravates the problem of fluidity of definition; perceptions of the state of the field and decisions about acceptance, rejection, value, significance, etc., will be different at various points on the research frontier. Lakatos' rationalisation is, therefore, inappropriate to the situation in which scientific actors must find themselves - making choices in relation to socially, culturally and historically-conditioned values (ibid. p.309-10).

Schuster develops the critique, then, by arguing that Lakatos' conception of the rationality of scientific practice fails on two counts: inadequacy and hermeneutical naivety. Firstly, it is inadequate because scientists working in a 'normal' scientific context can be rational by behaving in ways excluded from the Lakatosian model; this echoes Kuhn's criticism of Popper considered above. For example, in Kuhnian normal science progress is made by solving anomalies - narrowing the gap between prediction and observation - in some well-trodden area, an activity which will not result in the prediction of novel facts, (ibid. p.310-11). Secondly, it is hermeneutically naive because it fails to represent the complexity of the factors at work in scientific decision-making. Lakatos recognises that discretion and 'common sense' are necessary to avoid premature decisions and choices but the idea of objective judgements about progressiveness or degeneracy is seen as a "... profound mystification", (ibid. p.312). As indicated above, even within a given research programme different groups of scientists are likely to make different judgements, decisions and choices because of divergent interest and exemplars. Given problems of incommensurability, such that competing paradigms often do not credit the existence of certain of each other's problems, predictions and corroborations, the idea of rational comparisons of competing research programmes has little credence. Therefore, the context of scientific evaluation and decision is considerably more complex than Lakatos suggests and must be conceived in terms of social and psychological factors; rationality cannot be conceived as residing in objective judgements in a 'sophisticated falsificationist' framework but rather, necessarily, in situationally-relative value-laden assessments based on research interests, exemplars and capabilities (ibid.).

Finally, Schuster refers to the ontological basis of the Lakatosian

conception - the Popperian 'World 3' of objective knowledge. Lakatos, in fact, criticizes Kuhn's emphasis on the 'psychology of science' as neglecting the fact that the rationally reconstructed growth of science takes place in this World 3 of articulated knowledge independent of the knowing subject (Lakatos, 1970, p.177-80). As Schuster (op.cit. p.313) notes:

"The third world provided Lakatos' ultimate defence of his conception of what internal and external history of science should be. The former is to be the objective history of research programmes, their progressiveness and degeneracy, and consequent pattern of replacement and supercession. Actions and decisions in accordance with the objective relations of research programmes are correct and rational, and they result from relatively unclouded vision of the third world and a healthy psychological disposition to follow its lead. Actions and decisions not in accordance with the objective relations and scores of research programmes are non-rational, and are explained by the sociological or psychological distortion of awareness of the third world."

From the Kuhnian perspective, then, such a 'third world' is dismissed as a figment of the philosophical imagination which merely underlies "... mystifying rationalizations of whatever we happen to like (mainly 'the present')", (ibid. p.312). The rationality of science must, therefore, be seen not in universal methodological imperatives but rather in situationally-relative value judgements. Of course, this creates the problem of science being reduced to the other extreme of subjective idiosyncrasy but it is clear that Kuhn himself does not support arguments of extreme relativism, to the effect that any viewpoint can be defended as 'rational' (or, at least, as not 'irrational'). However, such arguments are developed by Feyerabend who further develops the relativistic elements of the Kuhnian problematic.

Feyerabend develops his position on the basis of a critique of the



mainstream philosophy of rationality which sees scientific progress as guaranteed by firm, binding principles and methodological rules (Feyerabend, 1975, 1978). Firstly, he develops the critique of the notion that it is 'experience', 'facts' or 'experimental results' which measure the success of theories and provide the only means of achieving progress rather than arbitrary change (op.cit., 1975, p.29-37). Having already outlined elements of this critique as represented in the work of, for example, Popper and Kuhn, I shall not dwell much on Feyerabend's arguments in this respect. However, it is interesting to make note of his conception of an 'observational ideology'. Arguing, conventionally, that knowledge and description of facts cannot be independent of theory he sees theories, experimental results, mathematical techniques, epistemological prejudices, judgements, decisions, choices, etc., as all indeterminate, ambiguous and inseparable from the historical background (ibid. p.66). Consequently, empirical evidence is inevitably 'contaminated' by an observational ideology which contains principles which are implicit and hard to test, and assumptions which structure observational terms and involve subjective components with no objective correlates (ibid. p.66-7).

On this basis, Feyerabend criticizes the notion that scientific rationality derives from the method of empirical testing. He argues that many facts can be known only in a context where several alternative, mutually inconsistent theories are available; therefore, the process of assessment requires a pluralistic methodology involving comparisons of alternative sets of ideas. In general terms, a commitment to a particular theory or idea (or epistemology) eliminates certain facts which would only become available through the consideration of alternatives. Such elimination of evidence helps to ensure the 'success' and survival of the original idea; the process becomes circular with the

decision to adhere to an idea guaranteeing its survival which, in turn, justifies continued adherence at the expense of alternatives, (ibid. p.39-45). He goes on ...

"... how can we possibly test, or improve upon, the truth of a theory if it is built in such a manner that any conceivable event can be described, and explained, in terms of its principles? The only way of investigating such all-embracing principles would be to compare them with a different set of equally all-embracing principles - but this procedure has been excluded from the very beginning." (ibid. p.45).

He therefore criticizes Popper's 'critical rationalism' as a standard of rationality because, he argues, the application of falsificationism would wipe out science as we know it and, indeed, would never have permitted it to start (ibid. p.1976). The distinction between the context of discovery (psychology of knowledge) which can be irrational, and the context of justification (logic of knowledge) which must be rational cannot be upheld; in fact, he argues, the essence of science is just that set of social, economic and political influences which are dismissed as irrational in the orthodox view (ibid. p.165-7). Moreover, he points out that the incoherence of Lakatos' attempt to 'retrieve Reason' deriving from the need to provide 'breathing space' for theories and the need for liberal standards which ...

"... make it impossible to specify conditions in which a research programme must be abandoned or when it becomes irrational to continue to support it. Any choice of the scientist is rational, because it is compatible with the standards. 'Reason' no longer influences the actions of the scientist." (ibid. p.186).

Like Kuhn, Feyerabend argues that standards and judgements influencing choices and decisions are necessarily a function of social, economic and political factors; such standards ... "come from the research process itself, not from abstract views of rationality ... "; they

are, like theories, a matter of ingenuity, fact and knowledge of details (op.cit., 1978, p.99). But whereas Kuhn remains committed to the idea that science does have its own rationality, Feyerabend insists that we must consider all traditions, viewpoints and ideologies on an equal footing. He rejects the validity of those 'internal' standards which Kuhn, in later work, saw as contributing towards rational progress; thus, he argues that considerations of simplicity, elegance, consistency, etc., can only be properly judged after the event, and since science is never a completed process (i.e. it is always 'before' the event) such criteria can never be necessary conditions of scientific practice (op.cit., 1975, p.24). Science, for Feyerabend, is an historically-conditioned social enterprise and the appeal to Reason is a political manoeuvre which strengthens the 'totalitarian tendencies' of society (op.cit., 1978, p.100). Only if we adopt the position that 'anything goes'; only if we reject all universal standards and rigid traditions; only if we allow all groups and individuals a say in a fully democratic society; only then can we hope to ...

"... gradually erode the narrow and self-serving 'rationalism' of those who are now using tax money to destroy the traditions of the tax payers, to ruin their minds, rape their environment and quite generally to turn living human beings into well-trained slaves of their own barren vision of life." (ibid. p.10).

The subjectivist challenge to the orthodox conception of scientific rationality, therefore, achieves a position of extreme scepticism in the arguments of Feyerabend. However, many philosophers, although agreeing with the fundamental elements in the critique of objective knowledge, are more reluctant to pursue the scepticist path. Instead, they attempt to reconstruct, and provide an alternative definition of, what it is that is rational about science. In so doing they reject the problematic which arises from the identification of the rationality

issue with the question of the extent to which science can provide us with 'true' knowledge about the world, and replace it with a problematic which is basically concerned with the extent to which science provides a basis for practical action in the world, and the extent to which it can be seen as 'rational' in relation to this purpose. We therefore arrive at a third position of criticism of the orthodox model of scientific rationality and within this position I shall consider two very different conceptions. The first represents an attempt to reconstruct the rationality of science in terms of its success in solving problems; the second perceives the 'rationality' of science as essentially invested in its ability to provide technical control over the world.

#### 2.3.4 Science as Problem -Solving

Various philosophers of science have attempted to provide a reconstruction of its rationality in terms of the extent to which it provides us with the knowledge to solve problems; I shall refer here to the work of Kekes (1976, 1977), Laudan (1977), and Ravetz (1971). The basis of their work is the argument that the traditional notion of the pursuit of truth should be at least relegated to a subordinate position if not dropped altogether; and such concepts as degree of confirmation and corroboration, falsification, verisimilitude, etc., should be correspondingly relegated as standards of rationality. The main test of a theory should be the extent to which it provides an adequate solution to a perceived problem.

Such a conception, then, is developed upon the basis of the criticisms of the orthodox model of scientific rationality outlined above. Briefly, there is agreement that observation is necessarily conditioned by theoretical presuppositions and expectations and that no universal method of testing theories against experience, such as falsificationism,

can provide guarantees of their cognitive well-foundedness. It is argued that the attempt to establish standards to provide such guarantees cannot be rationally justified because such standards are necessarily contingent upon theoretical presuppositions and assumptions:

"The acceptance of scientific inquiry as a paradigm of rationality requires a demonstration of the ... (rationality of) ... presuppositions upon which scientific inquiry rests. But such a demonstration cannot come from within science, since it would already presuppose what requires to be proven, namely, the presuppositions of science." (Kekes, 1976, p.83).

The answer is seen to lie in the more 'practical' criterion of problem-solving and, thereby, in a reversal of the orthodox conception of the relationship between rationality and scientific progress. In place of the view that scientific progress is contingent upon its rationality, which in turn consists in accepting those theories and statements which we have good reason to believe have the greatest truth-content; in place of this view we should adopt one which sees the rationality of science as contingent upon its progressiveness, the latter being more easily identifiable as involving the choice and acceptance of those theories (or series of theories) with the greatest problem-solving effectiveness, making no presuppositions concerning veracity or verisimilitude (Laudan, *op.cit.*, p.5-6; 122-5):

"(If) scientific progress consists in a series of theories which represent an ever closer approximation to the truth, then science cannot be shown to be progressive. If, on the other hand, we accept ... that science is an inquiry system for the solution of problems, if we take the view that scientific progress consists in the solution of an increasing number of important problems, if we accept the proposal that rationality consists in making choices which will maximise the progress of science, then we may be able to show whether, and if so to what extent, science in general, and the specific sciences in particular, constitute a rational and progressive system." (*ibid.* p.126).

Since there are certain important differences between the problem-solving accounts of science provided by Kekes, Laudan and Ravetz, I shall briefly outline the main characteristics of these accounts in turn. Firstly, then, Kekes' concern is to provide an answer to the 'philosophical smugness' of the scepticist challenge to rationality which has led to a 'flowering of unreason' in the forms of, for example, existentialism, astrology and 'ideologies of higher consciousness':

"If it were true that nothing could be justified by reason, then all honestly held convictions would have an equal claim on general acceptance, and argument would, indeed, be replaced by 'passionate intensity'. This would be a dangerous and undesirable situation, for the inevitable conflicts could then be settled only by force. The civilizing restraint of debate and criticism would disappear. If rationality is abandoned, then either 'anarchy is loosed upon the world', or dogmatism supported by brute force would prevail."  
(Kekes, 1976, p.1).

Kekes' arguments can, then, be seen as a challenge to the position developed by Feyerabend which attempts to avoid the dilemmas of the orthodox response.

Following criticisms of traditional responses to scepticism (pragmatism, common sense, ordinary language, Popperian science and coherence theories) and an outline for the reasons for their failure, Kekes elaborates certain requirements of a theory of rationality (cf. *ibid.* chap. 7). He argues that such a theory must provide both internal criteria for the rationality of theories and, more importantly, an 'external' standard which is rationally defensible without the support of a further standard (*ibid.* p.112). Further necessary but insufficient requirements include the justification of presuppositions, conformance to the rules of formal logic, an account of rationality in relation to

successful action, a critical outlook and a philosophical (rather than psychological) approach to rationality (ibid. p.113-5). The internal standards for the rationality of a theory are familiar from traditional philosophy of science including those of logical consistency, conceptual coherence, explanatory power and criticizability, the latter expressed in essentially Popperian terms (ibid. p.133-61). However, these internal standards are seen as insufficient to guarantee rationality and, in fact, as becoming relevant only after the proposed external standard is satisfied, viz. only after a theory is accepted as a successful problem-solver (ibid. p. 133-4).

In his external account, then, Kekes argues that theories are held against a cultural background of beliefs, prejudices, expectations, value judgements, myths, practices and, most importantly, problems (ibid. p.120; op.cit. 1977, p.353). Problems require solution and it is the role of theories to provide such solutions: "The problem, the theory and the solution provided by the theory jointly explain the point of holding the theory." (ibid.). Theories are seen as providing an imaginative account of reality and are to be accepted when it is recognised that if things were as depicted by this account the problem would be solved (op.cit. 1976, p.121). In spite of difficulties which arise from the theory-dependency of problem-perception, it is possible, Kekes argues, to distinguish between 'problems of life', occurring out of the process of human evolution whose solution is essential to human survival and well-being, and 'problems of reflection', arising from the need for prior choices between alternative solutions to 'problems of life'. While 'problems of reflection' are necessarily theory-dependent, Kekes suggests that 'problems of life' are prior to theory, arising out of the human condition; it is, therefore, in providing solution to such 'problems of life' that theories can be judged to be

rational (ibid. p.122-5; op.cit. 1977, p.355-7).

Consequently, Kekes argues that the 'life according to reason' is one where problems are solved through theories and theories are chosen and accepted on the basis of their ability to solve problems (ibid. p.165-7). Rationality is, therefore, conceived as a method which everyone should adopt:

"The justification of rationality is the justification of the employment of a method. The method is a device for problem-solving, and it should be employed because everybody has problems, because it is in everybody's interest to solve his (sic) problems, and because rationality is the most promising way of doing so."  
(ibid. p.167)

In this account Kekes retains a commitment to truth as a regulative idea to the extent that he conceives of 'problems of life' as being objectively definable, with their solution being dependent upon the degree to which theories present 'accurate explanations of reality'. The concept of truth is further subordinated in the second problem-solving account, provided by Laudan (1977). He argues initially that:

"Philosophers of science, by and large, have imagined that they can lay bear (sic) the rationality of science by ignoring, in their analyses, the fact that scientific theories are usually attempts to solve specific empirical problems about the natural world." (ibid. p.11)

Laudan identifies two types of problems which scientific theories are designed to solve. Firstly, 'empirical problems' are first-order problems occurring in the empirical realm and may be classified as 'unsolved', 'solved' or 'anomalous'; the latter are problems unsolved by a particular theory but solved by competitors and an important



component of science is the attempt to convert anomalous problems into solved problems, thereby extending the problem-solving capacity of a theory at the same time as removing cognitive liabilities (ibid. p.15-31). Secondly, 'conceptual problems' concern the characteristics of theories and the grounds of conceptual structures developed to solve empirical problems. Laudan argues that such problems lie at the centre of scientific disputes but are ignored in traditional empiricist epistemology. They may be 'internal' relating to conceptual inconsistencies within a theory, or, more importantly, 'external', relating to tension with other theories, with methodological norms of the scientific community, or with components of the prevalent world view (ibid. p.45-63).

Laudan argues, therefore, that the solved problem is the basic unit of scientific progress and that the aim of science is to maximize the scope of solved empirical problems while minimizing the scope of anomalous and conceptual problems; theories which solve more significant problems than competitors are to be preferred (ibid. p.66-8). But he develops the argument with reference to the ideas of Kuhn and Lakatos to the effect that it is not single theories which lead to predictions and solve problems but 'theory complexes' or 'research traditions' (cf. 'paradigms' and 'research programmes'). Such research traditions contain series of theories together with ontological and methodological guidelines; they cannot be assessed directly on an empirical basis but can be evaluated according to their success in defining and solving empirical and conceptual problems (ibid. p.71-82). The fact that success or failure of a research tradition does not reflect upon individual theories within the tradition is not problematical because no assignments of truth or falsity are made. The best available tradition is that which has the greatest problem-solving ability and this has no necessary connection with truth-value;

rationality consists in accepting that tradition, i.e. in making 'progressive' choices (ibid. p.40-3, 122-5).

Consequently, as indicated above, scientific rationality is defined in terms of progress and this, in turn, is defined in terms of the selection and acceptance of research traditions on the basis of their problem-solving capabilities. This is seen by Laudan as providing a general, 'trans-temporal and trans-cultural' parameter of rationality but he also recognizes the crucial importance of specific historical and cultural factors in the definition of scientific rationality (ibid. p.127-31). Echoing the trend of Kuhnian thought outlined above he argues that ...

"... we need a broadened notion of rationality which will show how the 'intrusion' of seemingly 'non scientific' factors into scientific decision making is, or can be, an entirely rational process. Far from viewing the introduction of philosophical, religious and moral issues into science as the triumph of prejudice, superstition and irrationality, this model claims that the presence of such elements may be entirely rational; further, that the suppression of such elements may itself be irrational and prejudicial." (ibid. p.132)

This theme is, in fact, developed more emphatically in a third problem-solving conception of science provided by Ravetz (1971) who sees science as a social and historical process, as bound by cultural milieu and world-view and yet, paradoxically, as providing 'objective' knowledge:

"(A) proper analysis of the social activity of science must be based on understanding of the very special goals of the scientist's tasks; and an analysis of achieved scientific knowledge must comprehend its character as a social possession, the product of an historical process. An analysis of science which unites these two aspects will be able to resolve the apparent paradoxes in its nature: that out of a personal endeavour which is fallible, subjective, and strictly limited by the context, there emerges knowledge which is certain,

objective and universal." (ibid. p.71)

Ravetz, therefore, proposes a conception of scientific knowledge based on four theses: that scientific inquiry is a craft; that the objects of science are intellectual constructs studied through the investigation of problems; that science is guided and controlled by methods which are mainly informal and tacit; and that the special character of achieved scientific knowledge is explained by a complex social process of selection and transformation of results of research into accepted 'facts' (ibid. p.71-2). He argues, then, that the recognition of the craft character of scientific work is fundamental to an understanding of how objective knowledge can be produced by a subjective and personal process. Craft work involves an intimate knowledge of materials and techniques based on learning and experience; scientists employ craft procedures and judgements, which are partly personal and partly social, in, for example, the selection and interpretation of data, the choice of techniques, tools and models and the interpretation of experimental results (ibid. p.75-101).

Ravetz argues that science is not a process of discovery of true laws of nature by empirical testing but rather a process of production of statements (e.g. reports, descriptions, laws, models, theories, etc.) by craft work on intellectually-constructed classes of things and events (i.e. theory-dependent constructs). Science proceeds through the creation and solution of problems which arise from 'problem-situations', defined as a recognition of a need for the solution of some problem as yet undefined, this recognition being based upon craft judgement (ibid. p.109-38). The scientific process is guided and controlled by methods, or criteria, judgements and standards for the assessment of the 'adequacy' and 'value' of problem solutions and

Revetz argues that such judgements and standards derive from a body of social principles and precepts which are largely informal and tacit, not susceptible to explicit testing. Problem solutions can never be known to be true or certain; they can only be judged to be 'adequate' and 'of value' by scientists on the basis of craft judgement, experience and training (ibid p. 146-76).

Finally, Ravetz argues that the statements produced by this scientific process must be accepted by the scientific community as 'facts'; that is, the products of an essentially subjective process must be 'transformed' into 'objective knowledge' by a social process which operates within the scientific community. This process involves anonymous refereeing and journal publication, recognition of 'value' and 'significance' for further work, reproduction and use of the results by others, and translation into new problem-solving work. Statements which survive this social process can be accepted as 'facts', as the closest thing to the truth about the world that we can possibly achieve (ibid p. 182-91). But it is likely to be an ephemeral object "...of very temporary usefulness and life.." (ibid p. 236). a product of particular historical, social and cultural milieu (ibid p. 237-8).

Ravetz therefore provides us with a highly complex account of the rationality of scientific knowledge in terms of problem-solving, one which, having rejected the notion of rationality through a universal and objective method, further develops the Kuhnian themes followed up in Laudan's work discussed above. In arguing for the rationality of scientific knowledge in terms of personal and social judgements, decisions and choices made in a particular historical and cultural context, Ravetz places a heavy burden on the behaviour and training

of scientists as individuals and as a community when defining rationality. Indeed, he does argue that such rationality depends heavily on an effective and enlightened code of ethics in science:

"...unless there is an effective ethic, even more refined than a 'professional ethic', this very delicate and sensitive work will not long continue to be well governed or well performed." (ibid. p. 313).

However, he also recognises that such a scientific ethic or ideology is based upon wider ideological, cultural and political characteristics of the society in which scientists are educated and live, and in which science stands in a particular relationship to economic, political and social practice. And within the context of advanced industrial society he perceives little scope for an ethic which will ensure the future excellence of science (ibid. chap. 11).

#### 2.3.5 Science as Technical Control

Emphasis on the social context of scientific activity brings us naturally to the consideration of the conception of science as underlain by the rationale of technical control. This conception has developed primarily out of the anti-positivist tradition of German historicism based on developments of the work of Marx. The views of, for example, Lukacs and the members of the 'Frankfurt School', particularly Marcuse and Habermas, see modern experimental and empirical science as being invested with a 'rationality' which must be defined in terms of a technical interest in control and domination of the world and in terms of the need to justify such control and domination.

Lukacs (1971) argues, then, that modern rationalism, based on the idealist conception of rational knowledge as a product of the mind (i.e. as the product of rational reasoning), contains the ideal of a universal system

founded upon the principle of systematisation; that is, the creation of a complete system of knowledge connecting up partial systems of forms on the basis of necessary connections inherent in the forms themselves (ibid. p. 111-7). The primary characteristics of the resulting programme of rationality are, firstly, the elevation of the methods of mathematics and geometry as essential to the development of formal systems of objective knowledge and, secondly, the development of a structure of cognition which attempts to isolate a closed system of necessary natural laws (ibid. p. 104-30). This programme has certain fundamentally important consequences. Thus, the more that scientific knowledge develops as a formally closed system of partial laws in the abstract world of pure thought, the more it becomes divorced and isolated from the 'real material base' which it is, in fact, its task to understand (ibid. p. 104, 127). Moreover, the fundamental goal of modern rationalism becomes clear in the principle of systematisation:

"This notion of system makes it clear why pure and applied mathematics have constantly been held up as the methodological model and guide to modern philosophy. For the way in which their axioms are related to the partial systems and results deduced from them corresponds exactly to the postulate that systematic rationality sets itself, the postulate, namely, that every given aspect of the system should be capable of being deduced from its basic principle, that it should be exactly predictable and calculable." (ibid. p. 117).

This ideal of knowledge implies, then, a particular concept of action; that is, action in accordance with the predictions of objective formal laws to exploit the resulting effects to the best advantage (ibid. p. 129-30). Herein, therefore, lies the rationale of control and domination in formal rationality, in stark contradiction with the 'freedom' and 'progress' which it is supposed to guarantee (cf. ibid. p. 133-4).

This contradiction in fact mirrors Marx's view of science as performing a dual role (Marx 1979 p. 693-700). On the one hand, it transforms the production process and "...subjugates the forces of nature and compels them to work in the service of human needs ..." (ibid. p. 700); that is, from this perspective science is seen as a liberating influence, playing an essential role in human emancipation. On the other hand, Marx saw that science in capitalist society becomes a productive force which exists in objective form in fixed capital or machinery, i.e. is appropriated by capital:-

"The accumulation of knowledge and of skill, of the general productive forces of the social brain, is thus absorbed into capital, as opposed to labour, and hence appears as an attribute of capital, and more specifically of fixed capital, in so far as it enters into the production process as a means of production proper. Machinery appears, then, as the most adequate form of fixed capital ....." (ibid. p. 694).

That is, science becomes a means for the exploitation of labour acting on the worker through the machine as a 'ruling, alien power'. In the last analysis, however, Marx sees capitalist social relations as a transitory phase of human history, and views science as ultimately a progressive force which can promote the liberation of humanity.

The arguments developed by Lukacs and members of the Frankfurt School, although based on Marx's analysis are more pessimistic about the progressiveness of science. As Lukacs indicated, the method and programme of modern scientific rationality may be inherently exploitative and this theme is further developed especially by Marcuse and Habermas. Marcuse (1964) focusses on technology and the system of domination which has been created by technical progress. Such progress in advanced industrial society increases the potential for the satisfaction of wants and needs of individuals but at the same time erodes their rights and liberties. The technical apparatus of production and distribution tends

to become totalitarian, determining socially needed occupations, skills and attitudes, individual needs and aspirations:

"Independence of thought, autonomy and the right to political opposition are being deprived of their basic critical function in a society which seems increasingly capable of satisfying the needs of the individuals through the way in which it is organised."  
(ibid. p. 1).

However, the repressive nature of technical progress is legitimised by its ability to constantly increase production and to appear as "...the very embodiment of reason for the benefit of all social groups and interests..." (ibid. p. 9). Thus, technical progress has, Marcuse argues, produced increased 'rationalisation' in two senses: firstly, in the form of scientific management which has increased productivity and living standards; and secondly, in the form of a pattern of 'one-dimensional' thought and behaviour which justifies the oppressive features of the system (ibid. p. 11-12, 146).

Marcuse sees these trends as related to developments in the scientific method, particularly to the post-Aristotelian trend towards abstract mathematical systems of formal laws. Like Lukacs, he views the trend, within idealist philosophy, towards 'operationalism', that is, towards the reduction of scientific knowledge to concepts conceived as artefacts and characterised by measurement operations, as leading to 'instrumentalism' in which science is justified in terms of the ability to predict nature, and therefore provide the basis for control over matter. The apparent neutrality of science in its manipulation of abstracted matter constitutes the 'positive' character; it becomes part of technology as a form of control and domination over nature and society, stripping the world of its concrete, historical, 'qualitative' character thus denying a rational basis to criticism and different ways of seeing and thinking (ibid. p. 146-58).



Marcuse, then, presents an essentially pessimistic view of the inherently repressive nature of scientific rationality and emphasises the difficulties of instituting revolutionary changes in a situation where relations of production and productive forces are tied in with domination and where...

"The web of domination has become the web of reason itself, and this society is fatally entangled in it. And the transcending modes of thought seem to transcend reason itself." (ibid. p. 168-9).

Moreover, Marcuse refers to the work of Husserl in relating the rationality of science to a kind of rationale of the human existence - a socio-historical project involving the domination and control of nature:

"The scientific abstraction from concreteness, the quantification of qualities which yield exactness as well as universal validity, involve a specific concrete experience of the Lebenswelt - a specific mode of 'seeing' the world. And this 'seeing', in spite of its 'pure', disinterested character, is seeing within a purposive, practical context. It is anticipating..... and projecting.... Galilean science is the science of methodical, systematic anticipation and projection. But - and this is decisive - of a specific anticipation and projection - namely, that which experiences, comprehends and shapes the world in terms of calculable, predictable relationships among exactly identifiable units. In this project, universal quantifiability is a prerequisite for the domination of nature. Individual, non-quantifiable qualities stand in the way of an organisation of men and things in accordance with the measurable power to be extracted from them. But this is a specific socio-historical project, and the consciousness which undertakes this project is the hidden subject of Galilean science; the latter is the technic, the art of anticipation extended in infinity....." (ibid. p. 164).

This theme is further developed in the work of Habermas who argues that the basic orientation of scientific inquiry has resulted from structures of human existence; from the imperative that the human species reproduces itself, at least in part, through "purposive-rational" action tied to a cumulative learning process (Habermas 1972 p.121-34,301-17; McCarthy 1978 p. 64). Scientific knowledge is formed within a framework which arises through the relation of the human species to its natural

environment in the labour process. This process involves a behavioural system of instrumental, feedback-monitored action which necessarily binds knowledge of nature to the interest in technical control over natural processes; knowledge is formed to guide purposive-rational behaviour (Habermas op. cit. p. 133-4 ; McCarthy op. cit. p. 62-3). The empirical-analytic sciences, therefore, represent a systematic and reflected form of this (pre-scientific) learning process which aim to produce an objective knowledge of the universal laws of nature for the purpose of gaining reliable technical control over nature (Habermas op. cit. p. 122-24; McCarthy op. cit. p. 63-4). Habermas therefore labels the basic orientation of empirical scientific inquiry a 'technical cognitive interest' (op. cit. p.308-9).

Habermas argues that this interest is reflected in modern science in the concern with the establishment of a universal method which will guarantee a form of knowledge which is objective, free from the intrusion of subjective intentions and which is therefore technically exploitable (Habermas 1971 p. 99; 1976A). In advanced industrial society technical control over nature has been expanded and administration of human beings continually refined; science produces technical recommendations for a purposive-rational action which reduces rationality to socio-technical control rather than 'collective action enlightened by interested reason' (ibid. p. 331-3). Consequently, instrumentalist scientific rationality has become a form of domination and exploitation.

In identifying the rationale of modern empirical science with this form of committed instrumental reason, Habermas points to an inevitable contradiction in the orthodox conception of scientific rationality (ibid. p. 334-8). The attempt to invest rationality in a method which will guarantee objective knowledge is motivated by the concern to

combat dogmatism, irrationality, 'pseudo-science'; to separate in principle the scientifically rationalised shaping of reality from value-laden attempts at enlightening consciousness. But this very concern represents an attempt to enlighten consciousness so the proclaimed idea of a value-free methodology fundamentally contradicts the value-laden commitment which necessarily underlies the pursuit of scientific knowledge. Therefore, in its definition of dogma and pseudo-science the orthodox conception of science in fact includes what it must tacitly presupposed as its own motivation, namely, "..... the convergence of reason and commitment..." (ibid. p. 338).

Like Marcuse, then, Habermas sees science in late capitalist society as an ideology, having become increasingly interdependent with technology as a leading production force, and contributing, as such, to a 'technocratic consciousness' which portrays social development as a process of scientific-technical progress, a matter of 'technical' decision-making which excludes practical questions and democratic discussion of them. (op. cit. p. 102-15). But Habermas is rather more optimistic than Marcuse about the potentially progressive and liberating influence of science, although this would again involve social and political change to overcome the de-politicising influence of technocratic consciousness and to create a new form of scientific rationality based upon 'communicative competence' viz. meaningful public discussion and re-politicised decision-making processes (op. cit. 1971; McCarthy op. cit. p. 13-14).

## 2.4 Conclusion

This survey of the controversies over the question of the rationality of scientific knowledge indicates the extent and intensity of disagreement between philosophers of different schools of thought, a disagreement which is arguably inevitably given the essential nature of the philosophical task. However, my intention is to establish that there are reasonable grounds for rejecting the attempt to lay down universal methodological norms and rules as a guarantee of the cognitive well-foundedness of science; and it can be concluded that the arguments against the orthodox conception of scientific rationality are sufficiently weighty to provide such grounds. On the other hand, this rejection does not necessarily imply an acceptance of the radical scepticist position which argues that science is inevitably 'irrational' and no different from other modes of reasoning in terms of the cognitive validity of its product. I shall further develop these arguments in the next chapter but it does seem that the most promising approach to the conceptualisation of what it is that is rational about scientific knowledge lies in the attempt to construct this rationality in terms of the social, historical and institutional context in which knowledge is produced with particular reference to values arising from that context and to the 'problems' which develop and require solution.

This much said, we can now proceed with a more specific consideration of problems of rationality in social scientific knowledge, that is, the major kind of knowledge which is brought to bear upon the debate about nuclear power development.

## Chapter 3 Rationality in Social Scientific Knowledge

### 3.1 Introduction

Our major concern, in analysing the cognitive dimension of the nuclear power debate, is with the problems of achieving scientific knowledge of social phenomena - with the question of the extent to which it is possible to derive demonstrably 'objective', or at least 'reliable', knowledge about the economic, social, and political implications of nuclear power development. Dispute is not, however, restricted to the realm of social science; in the controversy over the safety of nuclear power, for example, an important issue concerns the state of knowledge about the impact of low level radiation on human organs and body tissue and this, of course, is a product of biological science. Nevertheless, the central focus here will be on social scientific knowledge and, in particular, on knowledge relating to the economic aspects of the nuclear power debate. There are two main reasons for this emphasis: firstly, the importance of the controversy over the economic costs and benefits of nuclear power; and, secondly, the widespread view that economics represent the most 'scientific' of all the social sciences and therefore produces knowledge which can be accepted as cognitively well-founded and reliable. It can be expected, therefore, that any problems in economic argument will be manifested in the analysis of social and political implications.

The purpose of this chapter, then, is to commence an analysis of the 'scientific' nature of our knowledge about social phenomena in general and, more particularly, about the economic aspects of the debate about nuclear power. The orientation will be essentially critical. I shall firstly present a brief outline of the characteristics of the application of the 'orthodox' approach to science in the context of the development of social knowledge. Secondly, I shall consider some of the problems

inherent in such an application and attempt to develop a critique with reference to knowledge about economic phenomena. This critique will comprise two parts, the first referring to the general problems of developing economic theory, and the second considering in rather more detail the role of econometric model building in the formulation and testing of economic knowledge. This analysis will provide a basis for the consideration of a rather different approach to the problem of establishing the 'rationality' of knowledge about social phenomena.

### 3.2 Rational Social Knowledge: An 'Orthodox' View

The controversies over the possibility of a 'scientific' knowledge of society are even deeper and more extensive than those considered in the previous chapter. This results from a distinction that is commonly made between the respective objects of study of the natural and social sciences. Rex (1973 p. 212) presents the distinction in the following terms:

"Whereas natural science is an activity in which men (sic) formulate concepts in order to understand the behaviour of classes of objects or things, the human studies are concerned with the study of a particular class of objects which themselves have the curious characteristic that they may be thought of as having concepts about each other and about other objects." (ibid.)

Cohen (1968) conceives of the problem in more general terms. In the physical world entities have properties deriving from the sum of, and relations between, their component elements but the characteristics of these elements themselves exist independently of the entities in which they participate. On the other hand, while entities in the social world again obtain their characteristics mainly from the relations between their component elements, many of the characteristics of these elements themselves derive from the larger entities of which they are a part. Moreover, social wholes or entities are partly mental products and therefore have some characteristics 'above' the structure of relations between their parts (ibid. p. 11-13).

Now, while such conceptions undoubtedly attribute to the natural sciences a greater degree of objectivity than is warranted, the social sciences nevertheless do face more severe problems deriving from the nature of the object of study. A complex set of philosophical and methodological positions have developed and a number of important dichotomies have

arisen. Firstly, there exists the 'naturalist' versus 'anti-naturalist' dichotomy, the former arguing that conceptions of science developed in the natural sciences can be transferred, more or less directly, to the social sciences while the latter disagrees, arguing that no general laws can be discovered nor accurate predictions made about phenomena dependent upon human activity (Keat and Urry 1975). The latter position for example, is characterised by the 'Verstehen' school deriving from the work of Max Weber who argued that the social sciences are concerned with...

"...psychological and intellectual.... phenomena the empathic understanding of which is naturally a problem of a specifically different type from those which the schemes of the exact natural sciences in general can or seek to solve." Weber (1949 p. 74)

A second dichotomy has arisen in social science methodology from the problem of the relation of individuals to social wholes; the problem of reconciling observed social phenomena with a possible conception of a "...reality exterior to the individual." (Rex 1961 p. 60). One approach, deriving from Durkheimian sociology, is 'methodological holism' which is concerned with explaining the relations between social wholes in terms of the roles and norms associated with those wholes rather than the characteristics of individuals comprising them. The holistic approach has tended to stress the analogy between social wholes and organisms, emphasising 'systematic' properties and leading to functional explanations. An opposing approach is provided by 'methodological individualism' which sees social wholes as the sum of the individual parts and therefore explicable in terms of facts about individuals. This individualist approach can result in a tendency towards the 'reduction' of sociology to psychology.

Notwithstanding these problems and dichotomies the orthodox approach to the development of social scientific knowledge essentially involves



the application of that which holds sway in natural science on the grounds that a universal method can produce a scientific knowledge of society which is antithetical to 'ideology'. In spite of advances made in recent times by proponents of 'anti-naturalist' approaches to social science, there remains a dominant preoccupation with the problem of developing explanatory and predictive knowledge in terms of 'universal laws' or law-like generalisations which are tested by relating their empirical consequences to the accepted facts of experience (Keat and Urry op. cit. p. 88; Giddens 1974 p. 4). Again, such laws tend to be conceived in terms of well-established empirical regularities which permit prediction of observed states of affairs rather than causal relationships which permit explanation in the sense of an understanding of determining factors.

Consequently, the objective scientific method involving the conjecture of a hypothesis, the deduction of consequents, and the testing of such consequents in relation to empirical evidence, together with the constant attempt to criticise and falsify such hypotheses is seen to provide a logic of knowledge which guarantees knowledge of society which is free from the intrusion of attributes of the 'knowing subject'. Such subjective values, attitudes and goals are consequently prevented from 'contaminating' knowledge; the only values entering into theory are those implicit in the scientific method itself (e.g. in the selection of the research problem (ibid.; Oquist 1978 p. 147). Therefore, social science is seen as having a technical character, producing 'instrumental' (predictive) knowledge, with no implications, in itself, for practical policy or the pursuit of values and only justifiable in terms of the rational method used to produce it.

This approach, then, represents a development of the positivist tradition of social science whose concern has been to overcome the

influence of value judgements, prejudices, imagination and metaphysical speculation by establishing a rigorous science of facts based on observation. Within this tradition the holistic approach to the study of society is essentially a product of French sociology. The notion of a science of society was a later development of the 'Enlightenment' and was conditioned in France by post-Revolutionary economic and political conditions (Rex 1973 p. 91-2; Therborn 1976 p. 210-2). Comte, who is usually acknowledged as the founder of the 'science of society', believed that institutions, beliefs and morals in a society are interrelated as a whole so that the explanation of any one item in the whole must discover laws prescribing how this item coexists with all the others. Therefore, French sociology rejected rational individualism and utilitarianism finding its most sophisticated expression in Durkheim, in the late nineteenth century, who was basically concerned with constraints on human conduct deriving from the wider system of social interaction rather than from individual psychological factors (Rex 1973 p. 60-2). He believed that in order to be objective sociology must treat social facts as things independent of individual consciousness: he saw sociology as concerned with a 'reality exterior to the individual'. However, this created a problem of bridging the gap between observable phenomena and social reality and this has subsequently led to the adoption of the analogy between biological species and societies and of functional explanation.

The explicit doctrine of functionalism was the creation of Malinowski in the field of anthropology but it was developed and consolidated by Radcliffe-Brown during studies of pre-literate societies (Cohen 1968 p. 37-45). Such societies tend to be relatively stable with little historical consciousness and their institutions, beliefs and symbols tend to be interrelated in an apparently total pattern. In such a context, functionalism provides a systematising framework within

the positivist tradition. The problem of social order is approached through the analysis of institutional arrangements regulating social relationships; institutions are seen as functioning parts of the social system which maintain it in a more or less stable equilibrium condition (Goddard 1972 p. 63-4). Further, Radcliffe-Brown saw social anthropology as an inductive, non-historical science concerned with the establishment of universal laws governing the relations between social phenomena via comparative analysis of social systems with no reference to psychological factors (e.g. thoughts, feelings and motives of individuals) (ibid. p. 66-7).

Significant recent contributions to functionalism have been made by Talcott Parsons. Combining some of Malinowski's ideas with those of Pareto and Durkheim, he has focussed on the needs of the personality and analyses items in terms of their functions in relation to these needs (Cohen op. cit. p. 45-6; Rex 1973 p. 113-4).

Functionalist explanation, then, draws analogies from the biological sciences which are concerned with living, self-maintaining systems in which processes have the function of contributing towards the survival of the species and in this are mutually supporting and dependent (Lessnoff 1974 p. 109-11). Functionalist social scientists, therefore, see societies as systems of interrelated, mutually dependent elements which cooperate to ensure the existence and survival of the social whole. Due to this interrelationship the character of any one element in the system is explicable only by reference to all the others, and a valid functional explanation consists in showing in what way an element contributes to the functioning of the system to which it belongs (ibid. p. 122; Bailey 1975 p. 56-7). In general, therefore, elements of social systems are explained in terms of their desirable consequences viz. the survival of the system and its

maintenance in a condition of equilibrium. An example is provided by the explanation of prices in neo-classical economic theory in terms of their function in equilibrating supply and demand.

On the other hand, the 'methodological individualist' approach within the positivist tradition has been the hallmark of British social thought since Spencer developed his 'Principles of Sociology' in the late nineteenth century. A century previously Bentham and Smith had established the view that the way to the 'good society', with the maximisation of the welfare of all members, was through the free, self-seeking individual, and through the operation of market forces with minimum interference from the state. Spencer was an 'individualist' both in the sense that he believed that the free, spontaneous development of the individual was the prime political and social goal, and in that he saw social life as explicable in terms of individual members of that society (Keat and Urry op. cit. p. 79).

Although Spencer was concerned to reconcile the organic analogy and functional organisation of the social whole with the primacy of the individual, his sociology was rapidly overtaken by events; specifically, by the demise of small-scale competitive capitalism and the advent of the age of monopoly capitalism in the late nineteenth century in which emphasis came to be placed upon the collection of information about social conditions with a view to social reform to alleviate the conditions of the poor (Rex 1973 p. 57-8; Therborn op. cit. p. 230). Consequently, what Therborn (ibid.) calls 'Administrative Sociology' developed in Britain, somewhat in isolation from the more theoretical emphasis of European Sociology, concentrating on the empirical study of the quantitative characteristics of individuals rather at the expense of the developments of explanatory theory.

The combination of this individualist empiricist tradition with the development of logical positivism resulted in behaviourism attaining a position of some dominance in social scientific inquiry in this country. Behaviourists argue that social phenomena can be explained only by reference to the observable behaviour of individuals and not unobservable intentions, motivations or expectations which offend positivist criteria of 'corroboration' (Hollis and Nell 1975 p. 118). Therefore, observed regularities in behaviour are seen as constituting the basis for 'law-like generalisations' which permit prediction of patterns of behaviour and hence a satisfactory explanation. A well-known example of behaviourism in the social sciences is the 'revealed preference theory' of neoclassical economics in which consumers' behaviour as manifested in observable market decisions is taken as a firm basis for the development of 'economic laws'.

However, this epistemological position is subject to certain criticisms which can be introduced here in general terms. It was suggested in Chapter 2 that the applicability of the orthodox conception of scientific rationality is crucially dependent upon certain preconditions which cannot be satisfied even in the realm of the natural sciences. In particular, it presumes the existence of closed systems, in which the internal system structure and relationships with the external environment are constant (Bhaskar op. cit. Chap. 2). In the social sciences the problems of establishing controlled experimental conditions to achieve system closure become increasingly intractable because of the nature of the object of study: and even in cases where some degree of closure is possible the relevance of the resulting knowledge to the actual complex and dynamic social world is highly circumscribed. In other words, the idea that a theory is to be judged by its predictive

success or failure, and the specification of ex ante criteria for refutation have limited applicability if analysis must proceed in the context of open social systems where subjects, conditions and forms of action are characterised by diversity and constant change and where consequent events may have a multiplicity of complex causes and are not invariably realised (ibid. Hutchison 1981 p. 276; Weber 1949 p. 84-5).

The syntactical identity between explanation, prediction and falsification, such that a correct prediction is seen to explain and an incorrect one to falsify, is based on the assumption that there can be independent grounds for the initial conditions of an explanation. But the only such grounds which are available within the falsificationist conception are provided by immediate sense-experience and this in turn presupposes the existence of a theory-neutral observation language which can provide an unambiguous, 'non-contingent' designation of the elements of experience (Bhaskar op. cit. p. 134-6). In the social sciences the problem of the theory-dependency of observation is particularly marked and, consequently, the validity of a universal method of empirical testing in such a context must be highly questionable. As Ravetz (1971 p. 374) states:

"Where the objects of inquiry have but a tenuous relation to the real things and events they purport to describe, and are themselves ill-informed and unstable, an isolated investigation devoted to a supposedly 'empirical' test of some hypothesis about their relations, is highly unlikely to yield worthwhile results."

The problems associated with the application of this conception of rationality to the social sciences can now be considered in some detail in relation to the field of neo-classical economics, particularly the activity of economic modelling as a means to the development of economic knowledge.

### 3.3 The Rationality of Economic Knowledge

#### 3.3.1 An Outline Critique: Economic Theory

Within the neoclassical paradigm it is broadly agreed that the development of theory should proceed by way of the hypothetico-deductive method and that this method provides guarantees of the rationality of such theory (Blaug 1980 p. 127-8). This position is adopted, for example, in many textbooks which represent the mainstream neoclassical stance (cf. Samuelson 1973, Chap. 1; Lipsey 1963, Chaps 1-3). In the hypothetico-deductive system, models play a crucial role in the testing of economic hypotheses against observation data. A hypothesis is developed on the basis of pre-existing theory which is accepted within the neoclassical paradigm. In order to test this hypothesis against economic data it must be specified in empirical form, ideally, it is argued, as a set of mathematical equations with quantifiable parameters. The resulting model represents an abstraction of the real world, the process of abstraction of 'relevant' elements depending upon judgements, norms and practices embodied in the neoclassical paradigm, and upon the nature of available data. The validity of the model is then assessed in terms of the extent to which it yields predictions in conformance with economic observations; if it performs badly then it should be treated as falsified and rejected, whereas if it performs well then the hypothesis can be provisionally accepted as a basis for proceeding to further analysis.

For this programme to be acceptable, therefore, it is necessary that the process of testing economic models against observed data should be capable of providing unambiguous criteria for the rejection of false hypotheses about the functioning of the economic system. The classical position in this respect was stated by Milton Friedman in his 1953 essay

'The Methodology of Positive Economics', arguing that the validity of economic theory is to be tested not by the descriptive 'realism' of assumptions and premises, but by the accuracy of the theory's predictions (Blaug 1962 p. 672; 1980 p. 104). The falsificationist position is elaborated by Machlup (1978 p. 140-1). Hypotheses are tested by, firstly, deducing from them, and the factual assumptions with which they are combined, all the conclusions that can be inferred and, secondly, confronting these conclusions with data obtained from observation of the phenomena concerned. Such a procedure may cause the rejection of hypotheses if irreconcilable contradictions are found between the deduced consequences (predictions) and observations, but can never definitely confirm or verify hypotheses. Hypotheses which survive tests are, therefore, not-yet-refuted but never proven as true. An important element in this position concerns the role of assumptions; it is argued that the only decisive consideration in the question of building into theoretical models assumptions which it may not be possible to subject to direct empirical testing, is their 'usefulness' in making the models conform with observations (ibid. p. 94-5). Blaug (1962 p. 666) summarises as follows:

"Since the days of Adam Smith, economics has consisted of the manipulation of a priori assumptions, derived either from introspection or from causal empirical generalisations, in the production of theories or hypotheses yielding predictions about events in the real world. Even if some of the assumptions involved non-observable variables, the deductions from these assumptions were ultimately related to the observable world: economists wanted to 'explain' economic phenomena as they actually occur. In short, economists have always regarded the core of their subject as 'science', in the modern sense of the word: the goal was to produce accurate and interesting predictions that were, in principle at least, capable of being empirically falsified."

Now the process of subjecting economic hypotheses and models to empirical tests is in practice very complex involving several problematical stages.



Firstly, it is necessary to derive a set of 'acceptable' statements concerning the particular empirical conditions of relevance to the test; this involves, for example, identifying and measuring relevant phenomena and adjusting 'observed values' of economic variables to 'true values', net of measurement error and non-economic values. These activities clearly entail a considerable amount of judgement which is necessarily made in relation to the theoretical background from which the hypothesis itself derives. This theory-dependency can introduce a degree of circularity into the testing process such that 'acceptable' observation statements are those which do not falsify the hypothesis. This problem exists in addition to that which arises from the logical impossibility of decisive falsification in relation to theory-impregnated observation statements. As an example, one can point to two tendencies which are apparent in the process of determination of relevant observation statements within the neoclassical paradigm, which are 'theory-dependent' in the broad sense, and which contribute to the survival of neoclassical hypotheses from falsification. The first tendency is that towards the emphasis on variables which are susceptible to quantification and the consequent de-emphasis of factors which are difficult or impossible to quantify; while the second involves the neglect of certain classes of variables relating, for example, to social and institutional factors which are defined within the paradigm as irrelevant to 'economic' problems.

A second set of requirements of the testing process concerns the specification of criteria of application for theoretical terms, the use of other supporting theories, hypotheses and assumptions, and some application of logic and mathematics, all of these again dependent upon the theoretical framework. Thirdly, 'ceteris paribus' clauses must be specified to exclude external influences (i.e. 'close' the system)

and state the conditions under which the test is to count as decisive. Therefore, within the falsificationist conception, what must be subjected to test is not a single theory or hypothesis but rather a complex system of hypotheses assumptions, empirical descriptions and elements of logic and mathematics; if the system fails a test it is consequently rather difficult to know which part of it to reject. For example, the only way in which the economist can determine whether 'ceteris' are, in fact, 'paribus' is to assume the correctness of the hypothesis and measure the extent to which the observed facts fail to fit it - but, then, how can the hypothesis be shown to be false? Indeed, failure of prediction can always be blamed on wrongly adjusted variables and observation statements, on supporting hypotheses or on unsatisfied 'ceteris paribus' conditions but cannot conclusively refute the hypothesis (Hollis and Nell 1975 p. 25-38; Blaug 1980 p. 106).

Moreover, within the conception the economist is warranted in bringing into the testing situation additional assumptions to save hypotheses in difficulty:

"In the question of admitting additional assumptions into a theoretical model, their relative usefulness should be the only decisive consideration. If an assumption seems to be in reasonable conformance with observation or reliable testimony in a large number of instances, and with the findings of imagined introspection, and if it modifies the operation of our models in a way as to achieve greater conformance with observed phenomena of the real world (and if this degree of conformance cannot be achieved with greater or simpler assumptions), such assumptions should be eligible for admission to our models..." (Machlup op. cit. p. 94-5).

Clearly, the dependence of judgements about what constitutes 'reasonable conformance with observation or reliable testimony' and 'imagined introspection' upon theoretical preconceptions, and the allowance for the introduction of additional assumptions and ad hoc hypotheses, create

severe difficulties for falsificationism as a universal guarantee of rationality. Furthermore, in cases where some contradiction remains between the deduced consequences of a hypothesis and an 'accepted' set of observations, there arises the problem of deciding just what degree of contradiction can lead to rejection of the hypothesis or model, particularly if there is no available alternative theory explaining the same events which is considered 'simple', 'fruitful', 'appropriate' etc. Theories are usually overthrown by other theories not simply by empirical contradictions which are rarely clear-cut and absolute due to the basic inability to set up controlled experiments (closed systems) to test economic theories (Blaug 1962 p. 672):

"Since the criteria for accepting or rejecting economic hypotheses are statistical ones, no refutation or confirmation can ever be final. Statistical testing is essentially 'a game against nature': if we would rather reject true hypotheses than run the danger of accepting false ones, we raise the level of significance at which we screen hypotheses; on the other hand, if we are more worried about rejecting true hypotheses and less worried about accepting false ones, we lower the level of significance. Thus, the cut-off point at which we begin accepting hypotheses is entirely arbitrary and depends on our eagerness to obtain significant results, which in turn depends on the number of alternative hypotheses that are already available in the same area. In the final analysis, therefore, the degree of confirmation offered by empirical evidence in a field like economics is, itself, a matter of judgement of the balance of probabilities between competing hypotheses." (ibid. p. 673).

It is apparent, then, that strict adherence to the principle of methodological falsificationism would rule out much of what is presently practiced in the name of 'economic science'. Economics in fact contains many definitions, concepts and theories which are not empirically falsifiable and tautologies are often presented as substantial contributions to economic knowledge. For example, the concept of a negatively inclined demand curve in conjunction with an inclusive

'ceteris paribus' clause is not falsifiable because if quantity demanded and price are both observed to decline together while other prices and incomes remain constant (i.e. in apparent contradiction to the theory) it is always possible to save the original hypothesis by contending that tastes have changed (viz. 'ceteris' are not 'paribus') (ibid. 674). The attempt to rescue falsification by hypothesising that tastes are stable over the relevant period, and subjecting this hypothesis to empirical tests, must again fail because such tests themselves require 'ceteris paribus' clauses which can, once more, be blamed for any contradictions. Despite its unfalsifiable nature, the concept of the negatively inclined demand curve is generally accepted within neoclassical economic theory; however, its support can be seen as deriving not from its survival of attempts at falsification but rather more from its place within a wider body of theory, within a paradigm, which holds a hegemonic position in the field of economic analysis. Thus, the concept derives from that of 'diminishing marginal utility', but this latter concept is also tautological as Robinson (1962 p. 48) argues:

"Utility is a metaphysical concept of impregnable circularity; utility is the quantity in commodities that makes individuals want to buy them, and the fact that individuals want to buy commodities shows that they have utility."

Moreover, the hypothesis that individuals maximise utility and that in an equilibrium situation the ratio of the marginal utility of each commodity to the price is everywhere equal - such a hypothesis is unfalsifiable since observed preferences, from which utility is inferred, are inevitably a reflection of market prices. Price is the only possible measure of marginal utility so to say that an individual will consume a commodity up to the point where marginal utility is equated with price is tautological; for an observation of an individual's

consumption at a particular price it can merely be assumed that the price reflects marginal utility and that the individual is pursuing maximising behaviour (cf. Sayer 1976 p. 212).

More generally, the assumption of rational maximising behaviour by neoclassical economic agents is not amenable to empirical test. Thus, 'Rational Economic Man' (sic!) is a person who conforms to the neoclassical model so rational behaviour embodies the 'true value' of behavioural economic variables. But rationality is defined in terms of what the models predict and failure of prediction can always be blamed on 'irrational' behaviour; there can be no independent empirical test of the maximising hypothesis. Attempts to side-step prior assumptions of rationality have resulted in behaviourism which seeks explanation on the basis of observed regularities which allow predictions of patterns of behaviour. But the selection of economically 'relevant' and reliable patterns which are predictable requires some prior criterion and this leads quickly back to the postulation of maximising behaviour as such a criterion thus compounding the contradiction (Hollis and Nell op. cit. p. 53-62).

Returning to the hypotheses which are employed as a basis for arguments concerning the economic implications of nuclear power programmes it can be seen that there is little prospect of conclusive falsification. Setting aside the problem of future effects and concentrating only on that of establishing the nature of the present relationship between nuclear power development and GDP growth, it is not possible to set up empirical tests which would indubitably establish the rationality of the beliefs of either proponents or opponents of nuclear power. Rather, it would appear that such rationality is conferred more by the extent to which the hypothesis is consistent with the wider theoretical framework

which is conventionally accepted as 'scientific'. More specifically, then, the belief that nuclear power development has beneficial implications for GDP growth is regarded as rational not because it is falsifiable and has withstood successive rigorous attempts at empirical refutation but because of its location in (and importance to) a broader system of beliefs about energy and the economy which hold sway in our society.

This general point concerning the 'rationality' of particular economic beliefs was asserted by Keynes, in a wider context, with reference to the school of thought which maintains that economic systems are essentially self-adjusting and should not therefore be subjected to state 'interference' (a school of thought which has enjoyed a recent revival):

"The strength of the self adjusting school depends on its having behind it almost the whole body of economic thinking and doctrine of the past 100 years. This is a formidable power. It is the product of acute minds and has persuaded and convinced the great majority of the intelligent and disinterested persons who have studied it. It has vast prestige and a more far-reaching influence than is obvious. For it lies behind the education and the habitual modes of thought, not only of economists, but of bankers and businessmen and civil servants and politicians of all parties."  
(Keynes quoted by Godley (1983)).

The argument can be developed in more detail with reference to the forecasts of energy demand which have been produced by the Department of Energy as the basis for the formulation of policies in respect of nuclear power. Such forecasts, and the relationships from which they are derived, represent important elements in this broad system of beliefs about energy and the economy and underpin the specific beliefs concerning nuclear power and GDP. The forecasting system developed by the Department of Energy is built around an econometric model of

energy demand which establishes empirical relationships between economic variables and energy consumption and which is therefore an important basis of the perceived rationality of the official economic case in favour of nuclear power. Consequently, it is worth examining such models to see if their scientific quality can be established with reference to the falsificationist criterion. Such an examination will also provide a more specific analysis of the problems of developing economic science since econometric models represent the vehicles via which economic theories and hypotheses are subjected to empirical testing.

### 3.3.2 A Detailed Critique: Econometric Modelling

Econometrics, then, is concerned, in general terms, with the estimation and testing of economic models (Johnston 1972). Such models are intended to be simplified abstractions of certain features of the system of interest which will provide insights into the operation of that system and thus facilitate predictions of future development and the planning of that development with a view to 'improving economic welfare' (ibid. p. 2). From a falsificationist standpoint the task of the econometrician is to develop, and assess the performance of, economic models in terms of the extent to which they constitute ".... a sufficiently realistic picture of the economy being studied or whether a somewhat different specification has to be estimated." (ibid. p. 5-6). The position is summarised by Ramsey (1977 p. 20-1):

"The claim of economics to be a science must be based on its method. The scientific method is, very simply, the procedure by which ideas about how the world functions are continually tested, so that theory is confronted with reality. The more severe and challenging the test, the more we learn about our discipline, whether the idea under test is rejected or not. The short-run objective of every scientist is to try to refute the existing, or currently-entertained ideas; he (sic!) tries to test and if possible reject the conventional wisdom. If he succeeds, we know we must find other explanations. If he fails, our confidence in the prevailing view is increased.

Consequently, the fundamental role of econometrics is to specify the procedures required to test economic ideas."

This process involves several highly problematical stages: the specification of the appropriate economic hypothesis in the form of a mathematical model, given that the 'a priori' restrictions deriving from economic theory are not usually sufficient to yield such a precise specification; the collection and selection of 'relevant and



'appropriate' data: the estimation of model parameters using this data; and the testing of the estimated model to assess the 'appropriateness' and to decide whether or not it should be rejected (Johnston op. cit. p. 5-6). These problem areas are usually considered in two main categories: firstly, problems of model choice and, secondly problems of model estimation (Brada and King 1979 p. 588); however, these categories are in fact closely interrelated and interdependent.

Models, then, are representations and abstractions of phenomena or systems which exist in the real world; models are developed by abstracting from 'reality-as-perceived' those elements which are considered most relevant to the problem under examination. Models can be chosen to represent the system of interest to varying degrees of 'reality'; the problem is usually seen as one of choosing a model which contains a structure that approximates 'reality' to a degree sufficient for the purposes of the investigation being pursued (Koopmans 1970 p. 176). Model-building therefore involves a compromise between, on the one hand, the incorporation of all the principal relationships necessary to describe and explain a system and, on the other, the process of simplification and abstraction from perceived extraneous influences (cf. Koreisha 1980 p. 96). But the question then arises: on what basis do we decide just what is 'appropriate', or 'relevant', 'necessary', 'extraneous' etc.? In making such decisions and judgements theoretical preconceptions of the analyst must be of fundamental importance. In the absence of prior theory all we can say is that everything depends upon everything else. Although this is certainly true to a point it does not provide a feasible basis for the construction of models; selectivity is essential to model-building and in the process of selection theory must play a crucial role whether we admit it explicitly

or not (cf. Common 1976 p. 392).

The process of compromise and selection, then, involves judgements which are applied in relation to the norms and conventions of the theoretical framework, or paradigm, within which the modelling exercise is undertaken. Furthermore, such judgements can be seen to be influenced by such factors as the nature of the information available about the system (which is, again, theory-dependent), and the purposes for which the model is intended. For example, according to positivist criteria, models should ideally be as simple as possible, consistent with 'accurate predictions'. We can refer here to Machlup's argument, in relation to neoclassical economic models, to the effect that:

"...realism in a model constructed for the purposes of analysis is undesirable if it reduces its simplicity and may cause confusion by 'cluttering up' the model with irrelevant detail." (Machlup 1978 p. 78).

Moreover, if simplicity is seen as an important consideration for the purpose of analysis, then in cases where the primary purpose of a modelling exercise is the production of results useful to the process of policy formulation (cf. demand forecasts), rather than the analysis of the processes operating in the system, then we might expect even greater pressures towards the simplification side of the compromise.

In relation to the energy field, given, firstly, that a primary purpose behind the development of econometric models of energy demand has been to produce forecasts of demand as an input to the planning process and, secondly, that such development has been guided mainly by criteria deriving from a positivist epistemology, then the trend towards the use of simple linear models of energy demand can be readily understood. Indeed, the 1960s witnessed a mushrooming of modelling activity of this

kind, a product of the so-called 'quantitative revolution' which overlook the analysis of social phenomena, born of dual parentage - positivism and the rise of social planning. Mathematical modelling became synonymous with respectable scientific analysis in the study of social systems, particularly where the results could be 'applied' to produce insights for policy-makers (cf. Grahl 1979 p. 8). For example, the 'quantitative revolution' in geography provided the basis for the mathematical modelling of urban systems which resulted in many models being applied in the urban planning process, particularly in respect of urban transport systems (cf. Chorley and Haggett 1967; Wilson 1972, 1974). In the energy field, the Fuel Policy White Paper of 1967 presented forecasts of demand for the first time based on a quantitative modelling system and in the same year the Energy Model Group was formed in the then Ministry of Power (Pearson 1981).

In the initial euphoria of quantification scientific activity in certain areas of applied social studies came close to being reduced to model-building in which even the tenets of traditional positivist epistemology were neglected. The result was what Hindess (op. cit.) terms the 'vulgar epistemology of model-building'. Within this framework scientific activity is seen to consist not in the testing of theories and hypotheses against empirical observations but rather solely in the construction and fitting of models, developed on the basis of implicit preconceptions about the system of interest, to accepted theory-neutral observation data. Theory, in the traditional sense, takes a back seat; little attempt is made to explicitly test existing bodies of theory in the analysis of social phenomena. Models, in effect, become the new 'theories', based only in an implicit and haphazard fashion on pre-existing theoretical frameworks. Again, one can refer, for example, to the new 'theories' of spatial interaction developed in

urban geography in the late 1960s which were little more than a collection of models based on Newton mechanical analogies. The basis for this 'theory' was later rendered more mathematically sophisticated by the application, by Alan Wilson, of 'entropy maximising' methods - basically, statistical averaging procedures to estimate the most probable system states given certain constraints (Wilson, 1970, 1974).

This trend towards mathematical modelling was perhaps encouraged by the material social conditions which prevailed during the 1950s and 1960s. This period was characterised by a high degree of social stability and steady economic growth, at least up to the late 1960s. Consequently, many empirically observable and measurable social and economic variables became subject to strong and steady time trends (e.g. GDP, income, output, consumption etc). Simple models, expressing a linear relationship over time between such variables, therefore performed reasonably well in empirical terms in the absence of abrupt social change during the period over which data were collected.

In this context, then, developed the practice of using simple linear models to express energy consumption as a function of Gross Domestic Product and other time-trend variables such as population, manufacturing output and income. The economic content of such models, in terms of an explicit relationship with behavioural hypotheses of neoclassical economic theory, is negligible; rather, within the 'model-building epistemology', the model is the theory. The test of the model is the extent to which it 'fits the facts', but since such models are essentially designed to fit the available facts the 'goodness of fit' statistic can provide no indication of explanatory validity and therefore no warrant for prediction, the basic purpose behind the development of such models.

The underlying problem of models developed upon the basis of observed regularities between phenomena derives from their superficiality.

The so-called 'independent variables' of such relationships are themselves dependent upon the same processes which influence the level of energy consumption. In other words, all the observable and quantifiable variables which are commonly used in such regression models of energy consumption represent 'economic outputs' and correlations between them, far from constituting an explanation, represent rather superficial indicators to further analysis. It is hardly surprising, then, that such quantities displayed a high degree of temporal correlation over a period of reasonably steady growth, not subject to abrupt structural discontinuities, as was experienced during the 1950s and for much of the 1960s.

However, such simple models were eventually overtaken by events. The late 1960s and early 1970s brought some significant changes in social and economic terms as recession played havoc with smooth trends of economic growth, and appearances of social harmony began to crumble in the face of increasing industrial and social unrest. It is possible to suggest that such events contributed to a breakdown in the predictive performance of simple time-trend models fitted to historical data, and led analysts to increasingly question the links of such models to traditional bodies of theoretical knowledge. This can be seen as reflected, for example, in the new trend towards so-called 'behavioural models' which became evident in the early and mid-1970s in areas of social analysis concerned with aspects of economic behaviour. In a search for new respectability modellers now turned more explicitly to neoclassical economic theory for a 'behavioural basis' for their work. Again in the field of urban modelling, for example, 'utility' began to appear in an attempt to provide a theoretical basis to models concerned

with travel demand, residential location etc (cf. Wilson 1974).

In the energy field, the events of 1973-4 caused quite an upheaval as considerable increases in the price of OPEC oil drove up average prices of energy, resulting in the breakdown of the barriers which had developed to partition the energy market during the period of low prices, and in substantial changes in modes of energy consumption (Chateau 1975 p. 37-8; Chateau and Lapillonne 1978 p. 141-2). During the post-war period of relative stability in energy markets the price of energy was subject to comparatively little change (actually declining in real terms) and was therefore excluded as an explanatory variable from energy demand models based on trends over this period. However, with sudden increases in price, followed by short-term reductions in consumption, analysts began to reject non-price models, with their assumption of zero price elasticity of demand, and, increasingly, to insist upon the need to incorporate the price of energy as an explanatory variable. Much of the substantial effort which has been put, since the 'energy crisis' of 1973-74, into the modelling of energy demand has been concerned with such an incorporation. In this programme, moreover, analysts would appear to have 'rediscovered' the neglected link with neoclassical economic theory of demand as the source of hypotheses, assumptions and preconceptions for their attempts to develop a 'better science'. The position is well stated by Brada and King (op. cit. p. 589) as follows:

"The building of econometric models depends on economic theory to suggest possible causal relationships, to specify the form of the equations, to indicate which variables are likely to explain particular phenomena, and often to state 'a priori', the sign of particular coefficients. Thus, if any progress is to be made in econometric work, we must first understand what the difficulties have been with the underlying theory in the past and what changes must be wrought so that both economic theory and econometrics can progress more rapidly through mutual support."

As regards the analysis of energy demand as a basis for forecasting exercises, then, econometric models incorporating energy price variables are conventionally regarded as representing 'good scientific practice'. Certainly, as far as the Department of Energy is concerned, the development of such models represents a 'major improvement' in the methodology for producing energy 'projections' to provide a framework for the consideration of energy policy issues (Wigley, 1981; Department of Energy 1982). The basis for such confidence is essentially a faith in the notion that the process of testing such models in relation to empirical data provides a means of rejecting 'false' models and hypotheses, a means of reflecting upon the soundness of the underlying theoretical framework of neoclassical economics, and, therefore, a means of defending against the influence, on theories, hypotheses and models, of implicit judgements, perceptions and selective processes which represent the vehicle for evaluative and ideological 'intrusions'. Of course, to the extent that such methodological guarantees cannot, in practice, be maintained then much of what is taken for granted in the rationalist conception of energy policy formulation becomes highly problematical. To what extent, then, do price models of energy demand represent 'good science'?

The development of energy demand relationships is founded upon the neoclassical 'subjective theory of value'. The basic purpose behind their development is the determination of the social value of energy products as revealed in market activity, where social value is conceived in relation to the subjective preferences of rationally-behaving individuals for energy products as a means to satisfying desires for other services and products to which energy is a necessary input (Boulding 1973 p. 121; Uri 1981 p. 244). Consequently, the demand

for energy is seen as a 'derived demand' for a commodity as manifested in market exchange relationships.

The hypothesis from neoclassical economic theory to which price models of energy demand relate has been simply stated as follows:

"Neoclassical demand theory predicts that an increase in the general price level of energy relative to other prices would reduce its consumption, and similarly that a relative increase in the price of one fuel would tend to reduce its share of the energy market."  
(Webb and Ricketts 1980 p. 76; cf. also Department of Energy 1977 p. 4).

Certain observations can be made about such a hypothesis. Firstly, it implies a relationship of determination between price and consumption of energy - price changes will produce consumption changes. Secondly, such a hypothesis must necessarily be supported by 'ceteris paribus' clauses which state that the relationship specified will hold if, and only if, other things remain equal. In other words, the relationship between price and consumption of energy is abstracted from other factors which influence consumption (e.g. tastes, income, prices of other goods and services etc.). Thirdly, the hypothesis is stated at a high level of generality and, in order to be subject to any form of empirical testing, must be made operational by obtaining empirical measures for the theoretical terms and by defining the boundaries of the empirical system to be used in the test situation. These features imply certain problems in the specification and estimation of models, and in the process of testing hypotheses via such models.

The fundamental problem concerns the extent to which econometric models can actually represent the real causal structure of the energy system. Thus, severe specification problems arise from neoclassical economic



hypotheses of the kind outlined above. A severe form of specification error in econometric model building relates to the functional form of the demand relationship. In theoretical terms, as indicated above, energy demand is seen as derived from consumer preferences; more specifically the demand relationship is obtained from the maximisation of a consumer preference function subject to a budget constraint (Uri op. cit. p. 245). However, since such preference functions cannot be empirically determined their form is not known; some function must be specified and econometrically estimated. As Uri (op. cit. p. 246) argues:

".... we do not know what these preference functions look like so it is impossible to know the one exact functional form for the demand equation which yields an exact, quantitative estimate of demand elasticities."

The usual outcome is the choice of linear or log-linear relationships on the grounds of ease of estimation and interpretation (ibid. p. 247).

A second major form of specification error occurs with the omission of relevant, or inclusion of inappropriate, explanatory variables (Common op. cit. p. 320). The problem also extends to the specification of inappropriate 'independent' variables; thus, it is possible to select as exogenous variables which are actually dependent upon other variables, producing faults in the causal structure of the model. For example, the specification of energy consumption (endogenous, dependent variable) as a function of price (exogenous, independent variable) is in error to the extent that prices are influenced by levels of consumption. In the short term fuel prices are partly determined by the amount of fuel consumed in cases of stepped, multi-part tariff systems; higher levels of consumption mean lower average prices. In the long term economies of scale, deriving from increasing consumption levels (as general

prosperity increases and consumption habits change etc), results in lower real prices as, for example, the case of electricity has illustrated in the past. In the simple demand equation these effects would be wrongly presented as lower prices leading to higher consumption implying a price-elastic demand in situations where the real price elasticity may be zero. In such cases estimation of the model will not provide relevant estimates of 'real-world' elasticities and consequently cannot provide a decisive test of the hypothesis (cf. Halvorsen 1978 p. 7-9; Department of Energy 1977 p. 7, 45). This example illustrates how, with the available data on price and consumption, 'ceteris paribus' conditions must be violated in a time-trend analysis since economies of scale cannot be excluded from price-trend observations; a decisive test of the hypothesis is, therefore, not possible.

The source of this problem can be seen to lie essentially in the mode of abstraction used in the development of models within the neoclassical economic paradigm. In the positivist 'regularity theory of causation' explanation consists in the development of empirical regularities between phenomena which permit prediction. A distinctive characteristic of the process of theorising within neoclassical economics is, therefore, the focus on, and selection of, contingent 'ex post' phenomena of market exchange and the formulation of empirical variables representing such phenomena into relationships of statistical regularity (cf. above p 130 ). Both energy consumption and price are 'ex post' market outcomes which are dependent upon other technological, economic, social and political processes, and to express one as a function of the other within a linear econometric model is to impose a distorted relationship of determination that can have little bearing upon the explanation of real world processes.

Consequently, the process of abstraction and selection employed in developing such models can be seen as excluding many of the factors which are significant in the determination of the demand of energy. The grounds upon which they are excluded obviously relate to preconceived notions of 'relevance' which have their source in the neoclassical paradigm, and such notions may operate at different levels of explicitness. For example, there exist certain implicit theoretical notions about the irrelevance of certain social variables (e.g. social class). However, a particularly important criterion through which explicit selection occurs is that of quantifiability. On the one hand, special efforts may be made to find a quantifiable expression of variables which have an important place in the theoretical and conceptual framework (for example, the concept of 'utility'); on the other hand, variables may be perceived as relevant by virtue of their ready quantifiability (cf. market exchange outcomes) or, conversely, omitted on the grounds of an absence of appropriate numerical measures (usually compounding low theoretical priority). In this context, what has been termed the 'McNamara fallacy' has significant implications:

"The first step is to measure whatever can be easily measured. This is okay as far as it goes. The second step is to disregard that which cannot be measured or give it an arbitrary quantitative value. This is artificial and misleading. The third step is to presume that which cannot be measured easily is not really very important. This is blindness. The fourth step is to say what cannot be measured really does not exist." (quoted in Daly 1976 p. 9).

Examples of variables which are commonly omitted from energy demand models but which nevertheless can be seen to have an important influence on demand are: advertising and publicity, especially by energy supply corporations, consumer expectations and tastes: social attitudes to, for example, the 'convenience' of different fuels; and the costs,

efficiencies and lifetimes of energy-using appliances (Department of Energy 1977 p. 6, 45). More fundamental, perhaps, are variables relating to a wide variety of complex economic, social and political factors which constitute the wider determinants of the specific arena of contingent market exchange phenomena.

Variables relating to energy-using technology can be seen as particularly important omissions from the perspective deriving from neoclassical demand theory which emphasises the subjective preference of rational autonomous individuals to the neglect of the 'constraints' on individual behaviour and choice deriving from supply-side considerations and broader social factors. The influence of technology on energy demand is emphasised, for example, by Chateau (1975; cf. Chateau and Lapillonne 1978) who argues as follows:

"It is difficult to understand how a concrete economic system determines a level and a tendency in the consumption of energy at any given time. One can nonetheless insist on the primary role played by technology, since it is the technological choice at a given moment which implicitly determines future energy consumption." (op. cit. 1975 p. 38).

Chateau proposes that 'technology' can be seen to comprise three major elements: firstly, objects produced by the production system; secondly, processes used in the production system; and, thirdly, the equipment necessary for various production processes (ibid.). He then argues that such technology is important in determining the consumption of energy at three levels in the economic system. Firstly, as a raw material consumption is determined by the production volume of the industries using it as a raw material. Secondly, as a factor of production consumption is determined by, for example, the equipment used in the production process. Thirdly, as a final consumer good consumption is determined by the chosen equipment (e.g. heating appliances, transport vehicles etc) (ibid. p. 38-9).

Consequently, from this point of view, for many applications energy consumption must be seen as a complement to the consumption of expensive and long-lasting energy-using equipment (cf. the concept of 'derived demand') and changes in the efficiency and choice of equipment in response to changing fuel and equipment prices will have important effects on fuel consumption, effects which will vary over time (Department of Energy 1977 p. 46). For example, in the short term one would expect the response of energy consumption to price increases to be constrained by past commitments of investment in energy-using appliances. In the longer term, however, technological changes could be expected to occur resulting in a greater response in consumption (cf. a move away from energy-intensive products, increases in efficiency of energy-using equipment, changes in industrial production methods) (Chateau 1975 p. 39-40).

This distinction has led Khazzoom (1974), for example, to postulate the classification of 'captive' and 'free' demand for energy.

'Captive' demand is that which, at any one point in time, is immobilised by a given stock of appliances and which is generally immune to the influence of economic stimuli. 'Free' demand is that which can be reasonably expected to be responsive to changes in economic conditions (ibid. p. 360). Khazzoom then argues as follows:

"The predominance of the captive component in the total results in a reduction in the consumer's agility (or the producer's agility if the commodity in question is a factor of production) and the overall response of total demand to, say, price variations, will be much more restrained than economic theory would lead one to believe." (ibid. p. 364).

Models based on such theory, excluding important technological determinants of demand and their effects over time inevitably, then, face serious difficulties in the analysis of the response of energy consumption to

changes in economic conditions and, more specifically, in attempts to forecast future levels of consumption. The point has been well illustrated by Chapman (1976; cf. Energy Research Group 1976) who analysed the forecasting failures of the electricity industry in terms of the neglect, in demand forecasting models, of variables relating to trends and patterns of use of electrical appliances. However, as indicated above, the problem of neglect and omission of variables within the econometric modelling framework goes beyond the realm of technological determinants to social and political influences. Brief reference can be made to some recent work which is critical of this dimension of the 'superficiality' of economic modelling.

Chateau, together with Lapillonne (1978), developed his critique by outlining a framework for the more 'realistic' analysis of energy demand within the emphasis is placed upon identifying mechanisms behind growth and causal linkages. Two major types of 'determinants' of energy demand are seen as important (ibid p. 145-6). Firstly, 'direct determinants' may be technological (e.g. industrial process, modes of transport), socioeconomic (e.g. pattern of economic activity, consumer behaviour), and political (e.g. choices of decision-makers and economic aspects in respect of industrial location, process, equipment etc). Secondly, 'indirect determinants' exist at different levels including macroeconomic variables (e.g. economic growth rate and structure, income level and distribution, energy prices), organisational variables (e.g. settlement pattern, degree of centralisation, transport infrastructures), political variables (e.g. government policy-making), and, finally, social variables (e.g. social values and organisation).

The neglect of political influences on energy consumption is also emphasised by Erickson (1980) who employs a 'political economy' approach in the

comparative analysis of energy consumption in the United States, Sweden and West Germany, justifying such an approach in the following terms:

"In searching for the causes in national differences in energy consumption patterns, it does not restrict itself to the traditional economic topic of supply and demand. Rather, it focuses on the political dimension and highlights key public policies that structured the market and ultimately established or gave sanction to current use patterns." (ibid p. 113).

Erickson goes on to establish that significant degrees of consumption differences can be explained in terms of such factors as public transit and land use policies, fiscal and taxation policies, building standards and insulation practices, the characteristics and efficiency of energy-using equipment and technology, and the extent to which public authorities have promoted the use of total energy systems which make use of 'by-product' heat from electricity generation. He summarises his argument as follows:

"...it is critically important to recognise that public policy, not the 'pure' economic interplay of supply and demand has shaped the price structure and, hence, the market." (ibid p. 116)

"...market forces influence individual decisions, but the structure of the market itself is shaped by broader political and institutional factors. Among these are the attitudes and actions of utilities; the regulatory bodies that oversee them; their large customers; elective and appointed officials; and individual citizens as political and economic participants." (ibid p. 120)

A similar point is also forcefully made by Goode et al (1980). In the explanation of energy demand....

"...while individual free market style decisions by individuals are important and must not be neglected, nevertheless social decisions in this field are important, pervasive and in some instances dominant." (op. cit. p. 25).

Like Erickson, the authors of this study place the emphasis on such factors as land use and transport policies, taxes and subsidies, building regulations, standards and practices, institutional intervention etc (ibid).

All this is to argue, then, that, within the framework of econometric modelling of energy demand, many factors which represent fundamental determinants of demand are excluded from analytical attention. A meaningful analysis of energy consumption is therefore rendered extremely difficult within this framework. In order to make such models operational it is necessary to 'assume away' such factors as changes in relationships over time, changing expectations, tastes and attitudes, the effects of stocks of energy-using appliances and other technological, social and political influences. It is, indeed, necessary to assume in advance that the equations to be estimated represent a true description of the system of interest. In view of the specification errors inherent in such models this assumption is invalid, and to this extent the results of the estimation process can be seen as inappropriate to the analysis of the response of the system to the manipulation of policy variables, to the forecasting of future system states, and to the assessment of the validity of the underlying theory.

Severe problems of estimating econometric demand models would exist even if the assumption of correct specification were valid, but they are compounded by problems of mis-specification. Thus, the greater the degree of mis-specification, the greater the amount of variability in the dependent variable which will be due to factors which are (wrongly) assumed to be constant (i.e. to have no effect), and the greater the problems associated with estimating meaningful parameter



values for the variables which are included in the model. Moreover, the methods of testing the significance of such parameter estimates are generally not capable of unambiguously indicating that the model specification and its parent hypothesis are incorrect.

An important category of estimation problems derives from the difficulties of deciding upon appropriate empirical measures for the theoretical terms in the model. For example, what we are trying to explain, in theoretical terms, is energy demand, but what we can actually measure, in empirical terms, is energy consumption. However, an estimate of energy consumption elasticity is not the same as demand elasticity; the plotting of consumption and price data captures the intersections of supply and demand curves, but the consumption curve is not the same as the demand curve (Chateau and Lapillonne op. cit. p. 142). Again, there exist difficult problems in the observation and measurement of a significant price of energy. In theoretical terms the appropriate variable for inclusion in a demand model, for the purposes of estimating the price elasticity of demand for a fuel, is the marginal price since in neoclassical theory a necessary condition for utility maximisation is that the consumer equates marginal rates of substitution to the ratio of marginal prices of different fuels (Halvorsen op. cit. p. 7). However, marginal price does not incorporate all the relevant information about price tariffs, and a measure of average price is required in cases where price depends on quantity purchased in order to reflect the cost of intramarginal units (ibid. p. 7-8). This difficulty compounds the specification problem deriving from the dependence of long-run prices on consumption effectively preventing the explicit relationship of model to background hypothesis and theory.

Problems in achieving the identification of the demand relationship from the empirical terms of energy consumption and price exist independently of difficulties which arise from the quality of economic data, but are compounded thereby. For example, theoretical considerations may be overridden due to problems of obtaining data of a sufficiently disaggregated nature to permit estimation of variables which are meaningful in theoretical terms. Lack of disaggregated price data may force analysis involving aggregation over processes governed by different mechanisms and determinants, producing inaccurate estimates of elasticities; this can be an important problem in analysis of the industrial sector (Koreisha 1980 p. 97; Verleger 1974 p. 35). Moreover, the entire process of econometric estimation is founded upon assumptions of randomness and normality in data, assumptions which are difficult to test and, indeed, commonly violated (Georgescu-Roegen p. 261-2).

A particularly severe estimation problem arises due to the existence of the strong time-trends in many of the variables which are considered relevant to econometric models of energy demand, such as price, income and consumption (cf. above p.129 ). Consequently, difficulties arise in respect of serial correlation between observations on variables in time-series data:

"Energy consumption and economic activity have both grown strongly over time and this makes it virtually impossible to separate out the effects of any long-term trend in prices, or changing tastes. It is largely for this reason that we are reduced to measuring the effects only of fluctuations of price levels about their trend. Indeed, the problem is even worse than this, if we suppose that real price changes in the nationalised industries are correlated with the phase of the economic cycle (for which there is some evidence)." (Department of Energy 1977 p. 46)

The problem of multicollinearity plagues most attempts to estimate econometric demand models using time-series data. In the presence of linear stochastic relations between the explanatory variables of a model the precision of parameter estimates falls and the standard errors of estimates may be misleading. Basically, it becomes difficult to disentangle the relative influence of different explanatory variables and possible to wrongly reject variables, which in reality have an explanatory influence, on the basis of misleading information from significance tests (cf. Common op. cit. p. 362-2; Johnston op. cit. p. 159-60). More generally, it becomes difficult to discriminate between alternative model formulations which would provide an adequate fit to the data, the number of which proliferates in proportion to the degree of collinearity in the data (Grahl 1979 p. 13-14).

In an attempt to overcome the problem of multicollinearity econometricians commonly pool both time-series and cross-section data to provide variation in explanatory variables over both time and space (cf. Halvorsen op. cit.; Mount 1974; Department of Energy 1977 p. 19-43). But, as the Working Group on Energy Elasticities has pointed out, this does not necessarily eliminate the problem. Even in such studies, they argue, "... . there is still considerable multicollinearity and they have tended to produce elasticity estimates which are either statistically barely significant, or which are statistically significant but subject to controversy." (ibid. p. 46). Another possible response to the problem is to lengthen the time period of the study to collect more information, but this increases the likelihood of violated 'ceteris paribus' assumptions due to structural changes in underlying processes, and therefore creates severe problems in the use of the model to reflect on competing theoretical positions (Grahl op. cit. p. 14-16).

Problems of specification and estimation are, therefore, closely interrelated as the case of multicollinearity illustrates. If a demand model is specified in terms of 'explanatory' variables which all represent phenomena which are contingent upon the same underlying socio-economic processes then any attempt to estimate the model using time-trend data will inevitably produce problems of multicollinearity. In a sense, a situation of 'vicious circularity' is created to the extent that the initial problem of mis-specification produces subsequent problems in respect of estimation which effectively prevent the decisive testing of the model as specified. Only if the model is initially correctly specified can its correctness be tested! Moreover, the possibilities of breaking out of this situation are circumscribed by the nature of the system which produces the data for the estimation of such models. The stochastic properties of economic phenomena do not conform to the models of classical statistics, and enquiry into the nature of these phenomena cannot be pursued using 'controlled experiments' in which only one variable changes at a time and where reference can be made to 'control groups' (Brada and King op. cit. p. 588). In other words, economic data is conventionally extremely long on 'noise' and short on information, thus providing the scope for formulation and reformulation of a multitude of competing hypotheses and compounding, as indicated above, the problem of identification (Grahl op. cit. p. 16). Hence the need to make certain assumptions about stochastic conditions; and the estimation of any economic relationship must be made subject to specification, estimation and measurement errors of the kind outlined above. Econometric relationships cannot be precise functional relationships but rather are seen to represent 'mean behavioural patterns' as discernible for observed data (cf. Kelejian and Oates 1974 p. 33-5).

A closer look at the process of estimating econometric relationships will illustrate more fully the implications of these problems. An example of a typical functional form of econometric models of energy demand is provided by Halvorsen (op. cit). In a study of US electricity demand he presents a structural demand equation in the following log linear form (ibid p. 9):

$$\ln Q = a_0 + a_1 \ln P + \sum_{i=2}^M a_i Z_i + u$$

Here  $Q$  is the average quantity of electricity purchased per customer,  $P$  is the marginal price of electricity,  $Z_i$  are other exogenous variables and  $u$  is an 'error' or 'disturbance term' which incorporates both the inherent variability of economic phenomena and behaviour, and errors which derive, on the one hand, from the shortcomings of the model as a meaningful description of the real structure of the system in question and, on the other hand, from the problems of expressing such structure in the form of quantitative, empirical variables.

Consequently, it can be seen that econometricians normally deal with rather imprecise relationships and, indeed, in the estimation of such relationships the error term  $u$  can take on considerable significance. The role of this term would appear to be basically similar to that played by the 'ceteris paribus' clauses of economic theory (Koutsoyiannis 1973 p. 53). In economic theory it is postulated that functional relationships between variables are exact given 'ceteris paribus' assumptions (i.e. subject to other things remaining constant). However, since theories are necessarily abstractions from, and simplifications of, the complex relationships which hold in the real world, 'ceteris paribus' assumptions can seldom be fulfilled. In econometric models, therefore, the error term is used to accommodate

the changes in factors not explicitly incorporated into a relationship.

But a fundamental problem arises here. Just as in economic theory the requirement to use 'ceteris paribus' assumptions prevents the decisive empirical reputation of theories, so the inclusion of all data variability and specification and measurement errors in a residual  $u$  term can be seen as promoting the preservation of relationships once they have been specified and estimated. It is largely a matter of judgement as to whether the 'unexplained' variation in a relationship is sufficient to warrant its rejection, particularly as the source of this variation may not be specifically identifiable. It could be argued, for example, that omission of relevant variables and misrepresentation of the form of functional relationship are more serious errors than those arising from problems of estimation and measurement since the former involve changing the specification of the model. However, such distinctions cannot easily be made on the basis of a single value for  $u$ . Moreover, the judgement which must be brought to bear upon the question of the validity of an econometrically-estimated relationship as a test of an economic theory can easily be coloured by the interest of applied econometricians in obtaining empirical relationships which can be used to achieve practical results.

Indeed, the problem goes somewhat deeper than this. The estimation of the parameters ( $a_i$ ) of the relationship requires prior observations on dependent and independent variables and, strictly, on  $u$ ; but  $u$  cannot be observed directly and so the econometrician must make assumptions about the shape of the distribution of  $u$  which represent guesses about its true but unobservable values. It is conventionally assumed, then, that  $u$  is a normally distributed, random, real variable with, in any particular period, a mean of zero and a constant variance.

Further, it is assumed that the error terms of different observations are independent and that  $u$  is not correlated with any of the explanatory variables,  $Z_i$ . These assumptions can only be tested after the estimation of the model by examination of the regression residuals,  $e$ , which are taken as the estimates of  $u$ .

However, there are difficulties associated with this method. For example, there is no possible formal test of randomness of  $u$  because the true values of  $u$  are not observable and their estimates,  $e$ , are obtained with the assumption of randomness built into the estimation procedure. Similarly, the assumption of zero mean of  $u$  cannot be tested because  $E(u)=0$  is taken as axiomatically true for the purposes of estimation. As Koutsoyiannis (op. cit. p. 174) states:

"It is necessary..... to make the zero mean assumption so as to be able to apply the rules of algebra to stochastic phenomena and relationships. In other words, this assumption is imposed upon us by the stochastic nature of economic relationships, which otherwise it would be impossible to estimate with the common rules of mathematics."

Again, the assumption that  $u$  is normally distributed is difficult to validate because the regression residuals,  $e$ , may be effected by mis-specification of the model and hence do not always reflect the true distribution of  $u$ .

The usual approach adopted by econometricians to the question of the validity of the above assumptions underlying estimation procedures is either to ignore the implications of their violation or to attempt to rationalise them on 'a priori' grounds by assuming the absence of the very errors that the  $u$  term is supposed to accommodate. For example, it is commonly assumed in applied econometric work that

models as initially specified include all the important and relevant variables so that those excluded are individually unimportant and equally likely to have either positive or negative effects on the dependent variable thus offsetting each other. Moreover, it is usually implicitly assumed that there are no systematically positive or negative errors in measurement of variables and, again, that such errors will tend to cancel each other out. Finally, then, there arises the assumption that since  $u$  absorbs mainly the influences of numerous unimportant variables and 'erratic' elements in human behaviour, small values are more likely than large values; it is assumed to be more likely that the econometrician will make minor rather than major mistakes in decisions and judgements on what constitute important and relevant variables (Koutsoyiannis op. cit. p. 173-93).

Since the validity of some important tests of the significance of parameter estimates (e.g. t-tests, F-tests) is dependent upon the realism of such assumptions, doubts must be cast upon the process of econometric estimation in terms of its contribution to providing meaningful tests of hypotheses and models concerning the demand for energy. One can refer, in this context, to the wide range of results which have been produced by econometric studies concerned to estimate the response in consumption of different fuels to changes in their price relative to other fuels. The Working Group on Energy Elasticities has tabulated the results of several studies on the price elasticities of fuel consumption in various markets, illustrating the variation which arises due to the use of different assumptions, data and techniques (Department of Energy 1977, Annex III p. 19-43). The Working Group commented as follows:



"No two studies can be said to be analysing the same problem. Some differences are trivial - such as differing conventions for weather adjustment. However, some are probably very important, such as the differing time periods and geographical areas, the differing definitions of price (e.g. marginal versus average, and measured relative to other fuel prices or all fuel prices, or all commodity prices), and the exclusion or otherwise of stocks of energy using equipment." (ibid. p. 19).

In an econometric study of electricity demand in the United States Mount et al (1974) also refer to the controversial nature of demand elasticities with some studies indicating inelastic relationships, some elastic relationships and others being inconclusive (ibid. p. 323-5). In such a situation it is difficult to see how the econometric estimation of models of energy consumption can provide a means of decisive testing of hypotheses deriving from economic theory and therefore a means of guaranteeing 'good science' defined as objective knowledge free from the intrusion of evaluative and ideological themes.

Now, as we have seen, there is considerable scope for selectivity and judgement on the part of the analyst, exercised in relation to pre-conceived ideas and assumptions about the nature of the problem under analysis and, moreover, to the requirement often to produce results which are useful in terms of their contribution to policy-making:

"....those carrying out the studies are not always free from pressures to produce sensible looking results. It would be naive to suppose that, however much analysts try to be unbiased, this does not sometimes influence the detailed selection of data and methodology which are finally published. For example, studies which fail to reveal significant elasticities are less likely to be published." (Department of Energy 1977 p. 46).

However, such influences are likely to be much more pervasive than this, affecting the whole approach to, and structure of, the analysis, the process of variable selection, judgement about the importance of different sources of error and of violations of assumptions upon which econometric estimation rests, about the extent to which tests of significance of parameter estimates are valid, and so on. And such influences cannot be relegated to a 'psychology of knowledge' with their implications neutralised by the 'logic' of empirical testing.

Indeed, the basic approach to much economic work, especially that of an applied nature, does not conform to the philosophy, imperatives and ideals provided by the doctrine of empirical falsificationism, models which, nevertheless, are so widely accepted, on the philosophical level, as constituting the necessary criteria for 'good science'. In practice, therefore, given the stochastic properties of economic phenomena and the scope for judgement in what are rather 'messy' test situations, an insistence that economic hypotheses and models be formulated in such a way that they could, in principle, be indubitably falsified would result in the classification of much of economics-as-practiced as 'unscientific' against such criteria. Yet economics is conventionally regarded as the most 'scientific' of all the social sciences due primarily, indeed, to the development of econometric modelling as the supposed vehicle of empirical testing.

The method of indirect statistical inference, adopted in econometric work as the means to overcome the impossibility of isolating controlled experimental situations, can be seen, then, as embodying neither the spirit nor the letter of the falsificationist programme. The

fundamental problem has been outlined by Leontief (1971 p. 4) as follows:

"As theorists, we construct systems in which prices, outputs, rates of saving and investment etc, are explained in terms of production functions, consumption functions and other structural relationships whose parameters are assumed, at least for arguments' sake, to be known. As econometricians, engaged in what passes for empirical research, we do not try, however, to ascertain the actual shapes of these functions and to measure the magnitudes of these parameters by turning up new factual information. We make an about face and rely on indirect statistical inference to derive the unknown structural relationships from the observed magnitudes of prices, outputs and other variables that, in our role as theoreticians, we treated as unknowns."

Since much econometric work is undertaken within the context of contributing towards the formulation of policy, whether by firms or by government (cf. Ramsey op. cit.), the underlying concern tends to be more with fitting models to available data and deriving useful quantitative parameter values than with testing the validity of models and the underlying hypotheses and theories. Global goodness-of-fit statistics and correlation coefficients can lead to the rejection and reformulation of a model but provide only a superficial insight into the complex nature of possible defects; such statistics are suited more to the assessment of a model as a computational device than to its evaluation as an empirical test of theory.

In general terms then, the justification for the use of econometric models of energy demand as a contribution to 'improved' procedures of policy formulation is essentially instrumentalist: better forecasts of demand can be produced through an approach which is taken, almost without question, to be 'scientific'. It is often argued, that a test of such models does exist to the extent that predictions turn out to be wrong over the time period for which they are made. In

other words, we may have to wait some time for our falsification but it is nevertheless, in principle, eventually possible. However, there are two basic problems with this argument. Firstly, in order to produce a forecast of an endogenous variable (e.g. energy consumption), forecast values of the specified 'exogenous' variables (e.g. household expenditure, manufacturing output, GDP etc) are required and as much uncertainty may surround the latter as the former. In a model where 'exogenous' variables represent contingent economic outputs there may be no greater policy control over such variables than there is over the endogenous variable, nor any basis for greater confidence in their predictability. For example, forecasting of household expenditure and GDP is fraught with the same difficulties as forecasting energy consumption. Moreover, even if realised values of such 'exogenous' variables are, at a later date, used to test the output of the model against the realised value of the endogenous variable, any discrepancy can always be blamed on the fact that other things will inevitably have not remained constant. Indeed, this procedure is often used to re-estimate the parameters of the model against newly available time-series data, not to seriously reflect on the validity of its structure. The model may be modified somewhat but the soundness of the underlying theory cannot be thereby seriously challenged.

The second problem concerns the validity of realised, 'ex post' values of endogenous variables as a possible test of a model. If a model forecast is adopted at a particular time as a basis for formulating policies for the future then the realised value of the endogenous variable at a later date will inevitably be influenced by the adoption of those policies; in a sense, then, the forecast will be to a certain extent 'self-fulfilling'. Consequently, a realised value

of an endogenous variable at a later date cannot provide a valid independent test of a model. Furthermore, we need to know the validity of a model before it is used in the policy-making process; even if we could obtain such knowledge 'a posteriori' it would, by then, be too late since the model will have already been used as a basis for changing the system. The 'damage' will have been done and it will be irretrievable. Finally, as noted above, 'ex post' assessments can merely result in recalibration as a basis for new forecasts and policies; the system rolls on with no independent basis for refutation.

### 3.4 Conclusion

It can be concluded, then, that the conception of objective knowledge guaranteed as rational by the methodological imperatives of falsificationism has little validity in practice. If such imperatives were strictly imposed then much of what is currently accepted as 'scientific' knowledge of economic (and, indeed, all social) phenomena would have to be discarded. That such imperatives are unattainable has been demonstrated in the logical sense. That they are seen as inappropriate is perhaps reflected in social scientific practice; most social scientists pursue their craft in a way which does not conform to falsificationist strictures. Again referring to economics, Blaug (1980 p. 128) argues:

"Modern economists frequently preach falsificationism.....  
but rarely practice it....."

Of course, there is a relevant distinction to be made between arguments concerning the actual nature of social scientific practice on the one hand, and those concerning the desirable nature of such practice on the other. That falsificationism is not actually practiced does not itself invalidate it as a possible ideal of scientific practice; it is with reference only to logical arguments that such invalidity is demonstrable. Our concern here is essentially to understand the nature of social scientific knowledge as produced in our society: to understand the extent to which it is possible to derive social knowledge which is 'cognitively well'founded' or 'reliable'; the means by which such knowledge can be produced; and the 'deficiencies' in this respect which are present in the bodies of social knowledge and their means of production extant in our society. Having concluded

that falsificationism does not provide criteria relevant to this undertaking it is appropriate to proceed to an examination of other criteria which might be so relevant.

## Chapter 4: Rational Social Knowledge: Towards an Alternative Conception

### 4.1 Introduction

Knowledge about social phenomena which can be taken as 'reliable' or 'scientific' is an important commodity in our society. Public and private institutions and organisations must continually make decisions about courses of action and an important input to the decision-making process is available knowledge concerning the operation of social processes and the likely response of those processes to alternative courses of action. The discussion in the previous two chapters has attempted to indicate the difficulties in producing such knowledge and, more specifically, to demonstrate the illusory nature of conventional sets of ideas concerning its 'scientific' nature. However, in spite of these difficulties, recognised or not, the 'social requirement' for such knowledge (e.g. from the state for purposes of economic and social planning and from companies for the purpose of product planning and marketing) causing pressures for its production in 'useful' forms. This trend was discussed in chapter one and can be seen as producing a problem for the policy making process: as the demand grows for reliable knowledge to guide decisions on social and technological developments so too do the problems associated with the development of such knowledge.

The major components of this problematic can be briefly stated. Firstly, as the involvement particularly of the state in planning economic, social and technological development has grown, so has the requirement for useful knowledge to inform such planning activity. Secondly, the increasing complexity and scale of social and technological development has produced a greater demand for predictions and, moreover, longer planning lead-times and, therefore, a need to forecast further into the increasingly complex



future. Thirdly, the increasing scale of impact of social and technological developments on society and on the environment implies a need for more reliable knowledge about the nature of such impacts. However, fourthly, because of the problems of pace, scale and complexity of such change and the consequent difficulties of establishing controlled experimental situations in such 'open system' contexts there exist several obstacles to the production of social knowledge of demonstrable reliability (cf. Hutchinson 1977 p. 28-32; 1981, p. 284).

The problematic has evoked a distinctive response in the social sciences. Within the framework of orthodox positivistic epistemology the standard of scientific respectability is provided by the experimental natural sciences and the attempt to emulate such respectability in response to the above problematic has resulted in the widespread emphasis in the social sciences on quantification of phenomena and on the employment of mathematical modelling and computer techniques. Referring again to neoclassical economics, widely claimed to be the most 'effective' and 'mature' of the social sciences (Hutchinson 1977 p. 1), it is the development of mathematical economics and the fact that..... "economists, in their criteria, objectives, and methods, have attempted to follow much more closely and explicitly the natural sciences..." (ibid. p. 14) which is largely responsible for such claims of effectiveness. The developmental view of maturing economic science, proceeding along the secure and well-charted path of the natural sciences, is expressed by Neal and Shone (1976 p. 20), for example, as follows:

"If the economist is going to construct operational models so that he (sic!) can undertake the indirect tests of theories then these will be inevitably mathematical in form, and if they are not so at the present moment it will not be long before this comes about." (emphasis added)

Consequently, it can reasonably be argued that the essential hallmark of respectability and usefulness in the social sciences has become the ability to develop precise relationships expressed in mathematical form. It is by virtue, then, of the more ready susceptibility of the subject matter to quantification and the development of econometric modelling (in addition to pressures from the requirements of economic planning) that economics has come to be called the 'Queen of the Social Sciences' and the standard against which 'progress' and 'maturity' in other social sciences is measured (cf. Dror 1971). More generally, Nagel (1975), for example, stresses the need for social sciences to emulate the models developed in the physical and biological sciences and to employ mathematical and computer techniques. However, since such a trend cannot be justified in terms of the falsificationist framework we have the problem of gaining an understanding of the rationality of such knowledge as part of the wider task of understanding the nature of the process of production of social knowledge in our society.

#### 4.2 The Problem of 'Understanding' Social Phenomena

An emphasis, in the development of social scientific knowledge, upon the search for, and formulation of, quantitative mathematical relationships produces certain important implications. For example, focussing on the nature of such relationships can lead to a neglect of the problem of theoretical development or even the reduction of theory to mathematics. Mathematics is essentially merely a set of logical constructs which makes no direct reference to phenomena in social reality; if it is used as a tool in the explanation of social phenomena the translation between the mathematical and empirical domains must be regarded as highly problematical and crucial to the nature of the resulting knowledge. However, once such a translation is made (e.g. via the process of

selective abstraction) the problems and qualifications inherent in it are often forgotten and the domains become inverted: the mathematical relationship becomes the 'reality', considerations of 'substance' (i.e. the unique characteristics of social phenomena) become subordinated to the question of 'form' (i.e. the generalizable relationships between measurable characteristics). Shils (1949 p. vii) has commented on these trends as follows:

"(M)uch of the acceptance and appreciation of the utility of social science in the circles with the power to finance it and use it, extends largely to just those aspects of social science research which are almost exclusively descriptive or in which the task of explanation is disposed of by correlations of indices of ambiguous analytical meaning or by ad hoc common sense interpretations. The fact that correlations among the indices of ambiguous analytical meaning is often high and that the possibilities of successful practical manipulation are thus enhanced constitutes a barrier to our perception of the need for theory."

The nature of trends in social science since the time that Shils wrote these comments would appear to make them even more apposite today.

Lukacs (1971) is also critical of the 'naturalistic' approach to social science. He argues that if the ideal of knowledge is a formal system of mathematical relationships then this leads to the elimination of ".... every subjective and irrational element and every anthropomorphic tendency..." (ibid. p. 128); social science becomes radically separated from ethics and rational social knowledge is seen as free from the contamination of subjective value considerations. In other words, in such an approach knowledge becomes 'distanced' from the substantive objects of study in the interests of formal representation; considerations of 'realism' in relation to such objects become subordinated to those of methodology (cf. Machlup 1978 p. 78). The realm of the subjective is neutralised by that of the objective.

A further manifestation of this problematic concerns the neglect of the historical and institutional dimension of social phenomena, a dimension which, some analysts argue, is fundamental to an understanding of such phenomena and which essentially embodies the difference between them and the phenomena of concern to the natural sciences. Referring again to economics, Hutchison (1977 p. 94) presents Phelps-Brown's belief that...

"...we ought to value powers of observation more highly than powers of abstraction and the insight of the historian more than the rigour of the mathematician."

Hutchinson himself argues as follows( 1981 p. 276):

"Difficulties in quantifiability, heterogeneity, the absence of 'constants', the 'openness' or the 'complexity' of the material of social and economic systems, or what might be called the historical and institutional dimension (which implies the existence of only trends and not laws), these are all different aspects or ways of describing the different characteristics of the material of the social, as contrasted with the natural sciences."

And, finally, it is perhaps worth quoting at length the views of Kenneth Boulding on the contemporary trend towards mathematical economics:

"The antihistorical method leads to the development of slick technicians who know how to use computers, run massive correlations and regressions, but who do not really know which side of anybody's bread is buttered, who are incredibly ignorant of the details of economic institutions, who have no sense at all of the blood, sweat and tears that have gone into the making of economics and very little sense of any reality which lies beyond their data. We seem to be producing a generation of economists whose main preoccupation consists of analysing data which they have not collected and who have no interest whatever in what might be called a data reality function, that is, in to what extent a set of data corresponds to any significant reality in the world. The antihistorical approach, furthermore leads to a rejection of any information which cannot easily be fitted onto punched cards or their equivalents, and hence results in a distortion of the information input in the direction of that which can easily be quantified and away from those intangibles and imponderables which may nevertheless be an essential part of reality. The antihistorical school, furthermore, leads

into what I have called Ptolemaic economics, that is, an endless modification of variables and equations in regions of strongly diminishing returns in the knowledge function, and still sharper diminishing returns in the significance function. We seem to be engaged in finding out more and more numbers which mean less and less, and the parallel with the Ptolemaic epicycles is not difficult to draw." (quoted in Hutchison 1977 p. 95).

Objections to the application in the social sciences of the methods and procedures employed in the development of knowledge in the natural sciences derive broadly from the view, therefore, that the object of study in the two cases is fundamentally different. The implications of this view for the question of the rationality of social knowledge can be examined by considering the position which has developed in this respect on the basis of the work of Max Weber. Reference was made at the beginning of Chapter 3 to Weber's view that the task of explanation of social phenomena is very different from that of the phenomena of concern to the natural sciences. Whereas the latter are concerned to develop law-like generalisations based on the regular recurrence of relationships, Weber argues, on the contrary that:

"Sociology..... is a science which attempts the interpretive understanding of social action in order thereby to arrive at a causal explanation of its course and effects."  
(Weber quoted in Benton 1977 p. 113).

Therefore, Weber considered that action has the central place in sociology and saw its defining feature as 'meaningfulness':

"... in action is included all human behaviour insofar as the actor attaches a subjective meaning to it."  
(Weber quoted in Rex 1961 p. 78)

Only the individual is considered capable of 'meaningful social action' and action is social to the extent that it takes account of the behaviour of other people (Parkin 1982 p. 17; Benton 1977 p. 119).

The study of action, then, is concerned with the penetration of the subjective understandings of individuals in order to establish motives for social action. What is required is 'Verstehen', the comprehension of the meaning of social action through an empathic identification with the actor in order to be able to develop an explanatory understanding of the reasons and motives for action (Parkin 1982 p 19-20; Benton 1977 p. 120, 128-9).

However, Weber distinguished two levels of adequacy for such motivational explanations and in so doing made some concessions to the naturalist position which stand somewhat at odds with his basic neo-Kantian insistence on the methodological peculiarities of the cultural sciences. In addition to "adequacy on the level of meaning", which establishes plausible hypotheses in relation to intelligible sequences of motives, Weber insisted that explanations should be 'causally adequate', and this involves some empirical testing of hypotheses in order to establish generalisations of a law-like kind. (Ibid; Keat and Urry 1975 p. 145-7; Giddens 1974 p. 6-7).

Moreover, in the development of hypotheses adequate on the level of meaning, relating to actions defined in terms of cultural complexes of meaning, Weber argued that generic concepts (attempting to 'reproduce' social reality) were inapplicable (Weber 1949 p. 106). Interest in the "...concrete individually-structured configuration of our cultural life in its universal relations..." (ibid. p. 74) results in the need for 'ideal-typical' concepts designating not what characterises a class of phenomena, but rather a particular aspect of those phenomena manifest to a greater or lesser extent as an 'ideal limit' against which actual cultural phenomena can be compared and therefore understood and explained..." in their independence, their causal conditions and their significance." (ibid p. 92)

The formulation of ideal-types, then, involves the selection and accentuation of certain elements of social reality and Weber argued that the processes of selection and accentuation take place under the guidance of culturally-contingent viewpoints such that it is not possible to talk of a 'real essence' (ibid. p. 90-1). As Parkin (1982 p. 28 states):

"Social reality does not possess a real essence because it is always capable of being constructed or represented in various different ways. What counts as social reality depends pretty much upon the conceptual apparatus through which we view it in the first place."

For Weber, then, the selection and formulation of problems for investigation by the social sciences is 'influenced' or 'governed' by their 'value-relevance' i.e. by their relationship to motives and values arising out of cultural interests in a specific historical context (Weber 1949 p. 21-2, 61; 1978 p. 87-8). The explanation of the 'cultural significance' of social and economic phenomena must always, therefore, be founded upon an evaluative framework related to 'value-conditioned interest'; knowledge of social phenomena cannot be 'objective':

"There is no absolutely 'objective' scientific analysis of culture - or ....of 'social phenomena' independent of special and 'one-sided' viewpoints according to which - expressly or tacitly, consciously or unconsciously - they are selected, analysed and organised for expository purposes." (Weber 1949 p. 72)

In the development of such value-conditioned knowledge, Weber saw regularities, laws and universal propositions as playing a limited and specific role, as indicated above. Weber rejected the notion that the ability to develop law-like regularities is the decisive criterion for relevance and significance of social phenomena; knowledge of recurrent sequences plays only a preliminary role as a guide to cause and effect

and, therefore, as a rather limited means to the end of causal explanation (ibid. p. 72-80):

"The significance of a configuration of cultural phenomena and the basis of this significance cannot.... be derived and rendered intelligible by a system of analytical laws..., however, perfect it may be, since the significance of cultural events presupposes a value-orientation towards these events. The concept of culture is a value-concept. Empirical reality becomes 'culture' to us because and insofar as we relate it to value ideas." (ibid. p. 76).

Much more important in the development of meaningful knowledge of cultural phenomena, then, are the evaluative ideas of the investigator which arise from the historical and cultural context in which the investigator is located and which, as a form of social consciousness, become embedded in a conceptual, value framework upon which social knowledge is founded (ibid. p. 82). Benton (1977 p. 126) states Weber's position as follows:

"The general value framework in terms of which a cultural object is to be interpreted (i.e. in terms of which its concept is to be constructed) is.... a function of both the value framework in terms of which the cultural object was itself constructed..... and the value-choices of the historian/sociologist, these value-choices themselves being relative to the culture of the historian or sociologist concerned."

Weber's arguments, then, lead him into a relativist position; he sees all knowledge as a product of culture....

"...even the knowledge of the most certain propositions of our theoretical sciences - e.g. the exact natural sciences or mathematics, is, like the cultivation and refinement of the conscience, a product of culture" (Weber 1949 p. 55)

However, given a particular culturally-contingent value-framework, Weber insists that we can talk about 'objective knowledge' of social phenomena; in other words, while rejecting the notion of 'absolute' or 'universal' objectivity he nevertheless retains the idea of a 'bounded' or 'contingent'



objectivity. Fundamental to this position is his argument in respect of 'value freedom', and this argument will now be briefly outlined.

Weber defined value-judgements as practical evaluations of social phenomena subject to our influence as desirable or undesirable, satisfactory or unsatisfactory, whether on ethical grounds or on the basis of some attitude to culture, or for any other reason (Weber 1949 p. 1; 1978 p. 77). Basically, Weber argued that although the selection of relevant and significance problems and phenomena for analysis necessarily takes place in relation to values, the scientific analysis of those phenomena can and should be undertaken in a manner which excludes all considerations of practical evaluation. Such analysis is concerned only with factual descriptions and explanations and cannot establish the truth or falsity of any value-judgement. It is therefore imperative that the investigator keep "...unconditionally separate...." the establishment of empirical facts and practical evaluations of those facts (Weber 1949 p. 1-12; Keat and Urry 1975 p. 196; Lessnoff 1974 p. 131-6, 147-9; Ryan 1970 p. 230-1). In Weber's own words:

"What is at issue..... is exclusively the requirement , utterly trivial in itself, that anyone engaged in research or in presenting its results should keep two things absolutely separate, because they involve different kinds of problem: first, the statement of empirical facts (including facts established by him about the evaluative behaviour of the empirical human beings whom he is studying); and, secondly, his own practical value-position, , that is, his judgement and, in this sense, 'evaluation' of the facts (including possible 'value-judgements' made by empirical human beings, which have themselves become an object of investigation) as satisfactory or unsatisfactory." (Weber 1978 p. 78)

Consequently, if scientists heed this imperative and subscribe to the 'scientific values' of truth and objectivity our knowledge of society can be 'objective' according to Weber's 'bounded' definition; he

summarises his position as follows:

"...the choice of the object of investigation and the extent or depth to which this investigation attempts to penetrate into the infinite causal web, are determined by the evaluative ideas which dominate the investigator and his age. In the method of investigation, the guiding 'point of view' is of great importance for the construction of the conceptual scheme which will be used in the investigation. In the mode of their use, however, the investigator is obviously bound by the norms of our thought just as much here as elsewhere. For scientific truth is precisely what is valid for all who seek the truth" (Weber 1949 p. 84)

It is apparent, then, that in Weber's scheme much rests upon the investigatory's commitment to particular 'norms of thought' and to the 'search for truth' i.e. to a particular set of scientific ethics. The degree of 'objectivity' of social scientific knowledge which can be conceived of within the framework must, however, be highly circumscribed. There are two main problems. Firstly, having conceded the fundamental dependency of social knowledge on culturally-determined value-frameworks there must be a severe limit on the extent to which objectivity can be guaranteed by individual 'impartiality' within such frameworks. Secondly, the capacity of investigators to actually achieve the required standards of ethical neutrality in one part of the process of investigation when their work in the other part is admittedly determined by their values must be open to question. These problems can be elaborated further and related to the previous discussion of falsificationism.

In relation to the first problem the difficulty for Weber's notion of objectivity is illustrated by the consideration of the implications of the existence of divergent value-systems within a particular culture. In a culture composed of classes and groups with conflicting social interests and values and with the existence of competing 'general

views on life and the universe', there will exist, in Weberian terms, several alternative value frameworks and, therefore, several different possible 'knowledges' of social reality. In such a context the notion of a 'culturally-bounded objectivity' breaks down and becomes essentially equivalent to the 'epistemological anarchism' propounded by Feyerabend (cf. Chapter 2). Given such relativistic implications it is difficult to continue to adhere to the notion of 'objective knowledge'.

The second problem relates to the question of guarantees to ethical neutrality. For Weber it was, as indicated above, primarily a matter of individual integrity and adherence to the discipline attendant upon the 'pursuit of truth'. Clearly, however, this was not enough for those who wished to develop and 'firm up' Weber's notion of objective social scientific knowledge. There has been a tendency, therefore, by those of positivist philosophical inclinations, to reinterpret Weber's work through Popperian spectacles and to introduce empirical falsificationism as the necessary guarantee of objectivity. The first step is to interpret "Verstehen" as a method for capturing the 'meaning' of cultural phenomena rather than as the essential aim of the cultural sciences (as Weber saw it). (Benton 1977 p. 120). "Verstehen" can then be presented as a method for generating hypotheses about intentional action which are then subjected to empirical tests in an attempt to refute them (cf. Popper 1979 p. 179-85). In the Popperian position, it can be accepted that values play a role in the generation and formulation of hypotheses (i.e. in the 'psychology of knowledge' or the 'context of discovery'), but the discipline of specifying hypotheses in empirically falsifiable form (and indicating the conditions under which they would be rejected) and subjecting them to severe criticism and empirical tests (in the 'logic of knowledge' or the 'context of justification') ensures the objectivity of social knowledge. As Runciman (1972 p. 39) states:

"If explicability in principle has once been accepted, it does not matter where the social scientist's concepts and, therefore, his hypotheses come from but only whether the hypotheses are so framed that in principle, at least, they are capable of empirical disconfirmation."

The Popperian interpretation of the Weberian position can also be found, for example, in Taylor (1980) who argues:

"...what the phenomenological method suggests are ways in which we might, sensitively and humanely, arrive at hypotheses and theories to describe and explain people's behaviour, attitudes and aspirations in the situations in which they find themselves. In other words phenomenology is a theory concerned with the psychology of knowledge. But the logical question still arises as to how we might test the validity of any theories that we might come up with by phenomenological analysis, and here it can be argued that one must fall back on something like the Popperian scientific method of critically testing these theories by seeing if there is any empirical evidence which may suggest their refutation or revision." (ibid. p. 169)

Now, it has been argued, in the previous two chapters, that in order to stand as a valid, distinctive methodological position, falsificationism must provide guarantees of the cognitive reliability of social knowledge; that, in practice, no such guarantees can be provided; and that, in consequence, Popper's argument reduces, in the looser 'critical rationalist' form, to the establishment of a set of ethical imperatives or ideals which scientists ought to pursue. In relation to what social scientists can achieve in practice much of the falsificationist 'logic of knowledge' can be seen as a set of impracticable ideals which are all-too-readily invoked to justify and support knowledge which is in fact developed with little reference to them. Taking what is actually practicable in Popper's position brings us back nearer to Weber's original position of reliance on the subscription of individual scientists to particular 'norms of thought'. However, Weber's insistence on the dependency of bodies of social knowledge on culturally-contingent value-frameworks provides a considerably more coherent account of the

nature of social science, although in the looser form Popper's argument must forego the distinction between the psychology and the logic of knowledge and accept the significance of the former for the nature of the final product.

Consequently, it is possible to move towards a position from which an understanding of the nature and rationality of social knowledge in our society can be achieved. Based on our considerations of Weber's arguments we can accept that social knowledge is a product of culture, is founded upon value-frameworks which are culturally determined, and is formulated from particular value-relevant points of view of which there may be several in a particular cultural context due to the existence of various classes and groups with divergent interests and world-views. On the question of the 'cognitive reliability' of the knowledges which thus arise, it has been suggested that both the Popperian and Weberian positions effectively reduce to a recognition of the central importance of the behaviour of scientists, as individuals and as a community, in terms of the rationale of judgements, decisions and choices. A necessary corollary of the argument of the importance of adherence to particular 'desirable' values and standards for the achievement of 'good science', is the argument that the 'quality' of current social knowledge in our society is contingent upon the values and standards which are actually currently present in the social scientific community.

On this basis it is possible to refer back to the neo-Kuhnian position outlined previously (cf Chapter 2) which also places prime emphasis on the dependence of the process of knowledge formation upon its social and historical context. From this perspective the process of knowledge formation is seen as a social-psychological process, an essentially value-conditioned enterprise in which scientific knowledge is a product of socially- and historically-conditioned, value-laden judgements,

choices and decisions. This perspective accords well with our 'neo-Weberian' approach, which accepts Weber's arguments on value-relevance but rejects his position on value-freedom as inconsistent with his wider position. This, indeed, is argued by Parkin (1982) who suggests that the specification of an imperative for scientists to make every attempt to distinguish between statements of empirical facts and value-judgements and to avoid making value-judgements cannot guarantee that results are value free:

"The working assumptions that guided the research, and the choice of concepts employed, would ensure that the final product had a certain moral coloring..... Weber offers no guidance on how it would be possible to arrive at value-free results with the aid of these constructs." (ibid. p. 33)

Of course, this does not imply that Weber's strictures are irrelevant or inappropriate. It is indeed possible to legitimately insist that scientists are as thorough and impartial as possible, and pursue their work with maximum integrity, without pretending that objectivity is thereby guaranteed. Conversely, the recognition that science is ".... a species of value-conditioned practical judgement....."

(Schuster 1979 p. 307) does not provide a warrant for scientists to abandon any attempts to proceed with 'scientific integrity'.

Referring again to Parkin's comments on Weber's position:

"He could have conceded that since all forms of social enquiry entail the use of concepts and constructs that are morally tinted, the research product could not possibly be value-free. At the same time he could quite reasonably have sustained his case against partisanship in the lecture room and in academic publications. The sociologist cannot, try as he (sic!) may, avoid making value-judgements in his work. But he can avoid spouting his own tedious opinions on this and that. The fact that implicit evaluations cannot be expunged from social enquiry is no warrant for giving a completely free rein to the soap-box brigade." (Parkin 1982 p. 33-4)

### 4.3 Values and Rationality in Social Scientific Knowledge

As a product of human thought and activity in a particular socio-cultural context social scientific knowledge must be seen, then, as inevitably conditioned and moulded by judgements formulated in relation to the ethical and moral dimensions of social existence. The recognition that there can be no guarantees of value-freedom and objectivity re-focusses attention on the question of 'scientific ethics'. It has been suggested that the Weberian and Popperian positions effectively reduce to a set of procedural maxims or scientific values and imperatives: that we should attempt to avoid making value judgements and that we should subject our theories and hypotheses to the severest critical tests that we can devise. The rationality of existing social knowledge certainly cannot be established by appeal to imperatives but adopting this position raises some important questions concerning the nature of the procedural values currently pertaining in our society and the relationship between such values and the social and cultural context.

As regards the question of the current nature of 'scientific ethics', it would appear that an important implication of the development of positivist social science has been the tendency to neglect the problem of such ethics as essentially irrelevant because of the alleged methodological guarantees of objectivity. As Blaug (1980) argues in relation to economics, the development of mathematical modelling and the lip service paid to Popper appears to provide most economists with sufficient self-assurance as to the 'scientific' quality of economic knowledge. The result has been the development of a rather un-critical and complacent attitude towards the value judgements which are actually inherent in economics because of the adherence to the 'ideology' of value-freedom (ibid. Hutchison 1977, 1981). As regards economic science,

then, current practice would appear to fall short of the ideals propounded by Popper, producing a situation in which many value-laden concepts and constructs are falsely presented as objective knowledge (Blaug 1980 p. 153-4).

In considering this problem, the question of the relationship of scientific practice to the social context in which it takes place becomes important. If we support the argument that the socio-cultural context has an important determining influence upon the character of social scientific practice and its products then we must be aware that any procedural ideals that we propose might require special socio-cultural conditions for their implementation and acceptance. When Blaug (1980) and Hutchison (1977, 1981), for example, argue that economics should introduce and adhere to the principles of critical rationalism, involving "... constant criticism, and the constant pressing of critical distinctions and demarcations as far as they will go .."...(Hutchison 1981 p. 270), they imply that it is simply a matter for decision by the scientific community to adopt these principles and that there are no social and political factors which might have to be changed as a precondition for such an adoption. Hutchison (op. cit. p. 298-9) does, however, provide some insight into this problem by arguing that critical rationalism does presuppose an 'open society'.

"All methodological prescriptions are inevitably based on some kind of ethical or political presuppositions or valuations, and we are assuming as one of the presuppositions or purposes of our prescriptions than an opposition to dogmatism must be the intellectual foundation of a pluralist or 'open' society, where there are no privileged or protected positions." (ibid. p. 298)

A fundamental problem faced by proponents of critical rationalism, then, concerns the means by which political change is to be brought about to



create the necessary socio-cultural context for such a procedural ideal.

The social and political context of social scientific activity is therefore of fundamental importance to an analysis of the nature and rationality of our knowledge of social phenomena providing the differentiation and structuring of interests and 'world views' and therefore of evaluative perspectives on the social world which influence the determination of problems, concepts and constructs of analysis and the nature of scientific ethics and behaviour. The process of knowledge development involves various conceptual, theoretical and methodological judgements and decisions of 'relevance' and 'appropriateness' which are made in relation to value-frameworks. Such commitments, largely tacit and implicit can be seen, in Kuhnian terms, as constituting a 'paradigm'. Since there exists differentiation of values and world-views between different classes and groups in society, knowledge of social phenomena develops from 'particular points of view' and conflicting interpretations of the same phenomena arise.

A particular body of social knowledge is therefore characterised by its value commitments as expressed in its concepts, constructs and working assumptions, and in the judgements and interpretations which went into its development. It can therefore be expected that an important factor in the determination of the extent to which a particular body of knowledge is regarded as 'rational' is the nature of the value commitments upon which it is founded. Different societies are characterised by different sets of 'conventional' or dominant values and the pattern in this respect relates to the characteristics of the social structure. What is seen as 'rational' and 'scientific' in one society may not, therefore, be so regarded in another. Similarly,

within a society, given the existence of certain values which are considered to be 'conventional' and dominant, what is regarded as 'rational knowledge' will be that which has a 'moral coloring' which accords with those values. The basic problem here is one discussed by Weber (1949) viz. that dominant values in a society which are presented as widely accepted and conventional are taken as self-evident and thereby transformed into ethical imperatives with an apparent 'scientific' backing.

Indeed, Weber argues that the problem goes somewhat deeper than this to the extent that value judgements are (illegitimately, he argues) derived from 'factual assertions' about past trends and tendencies (ibid. p. 27-38). He cites the example of the concept of 'progress' which, he argues, can be used non-evaluatively to mean the "...continuation of some concrete process of change viewed in isolation.." but can easily take on an implied evaluative meaning viz. an increase in value. The problem is then that this evaluative meaning gains authority from the 'scientific' work which established the trend. Weber also refers to the economic theory of rational consumer behaviour with perfect information which, he argues, has been taken by supporters of free market philosophy as a picture of the 'natural' state of affairs and has therefore been elevated into a moral imperative (ibid. p. 44). These two tendencies, then, (the attachment to observed social trends of implied evaluative meaning and the elevation of widely accepted values, which appear self-evident, to the status of ethical imperatives) have the effect of producing biases in the perception of rationality in social knowledge towards that which embodies conventional, dominant values and values which imply the continuation of 'business-as-usual' without radical social change.

To the extent, then, that the apparent rationality of a body of social knowledge derives from its 'moral colouring' or embodied values there arises a situation where a particular set of values is being promoted in the name of 'value freedom' and therefore legitimised by the authority of 'science'. If we reject the notion of value-free social science as illusory then we have to contend with the notion of 'ideological knowledge' or knowledge, the value-contingency of which is concealed behind the facade of objectivity. This notion is obviously of considerable importance to our position so it is worth briefly examining in rather more detail the concept of 'ideology'.

#### 4.4 The Concept of Ideology

'Ideology' is a term which must be used with considerable caution and, indeed, much confusion is generated by the widespread tendency to employ the concept without explicit definition. The problem is that the meaning of the concept is dependent upon the epistemological standpoint within which argument is developed: there are as many alternative possible meanings as there are alternative epistemologies. Larrain (1979) presents a discussion of the meanings of ideology and argues that it can be conceived of in two ways. Firstly, it has a 'positive meaning' as.....

"... a system of opinions, values and knowledge which are connected with certain class interests and whose cognitive value may vary." (ibid. p. 172)

In this sense ideology is not seen as contrasting with science but rather all knowledge is to some extent 'ideological', even that which is based upon scientific premises. On the other hand, ideology can be conceived of as having a 'negative meaning' as essentially distorted knowledge, in contrast to science which is seen as true knowledge:

"While ideology remains trapped in the appearances, science manages to penetrate the phenomenal forms of reality, uncovering the laws and the real relations beneath the surface." (ibid. p. 173)

However, ideology may be viewed in this latter, negative sense from two very different epistemological standpoints. Firstly, from the positivist position ideology is the antithesis of science, comprising distortions and dogma founded upon value-judgements, which can be overcome only by the application of a universal scientific methodology. Alternatively, from the standpoint of Marxist dialectical materialism, ideology and science refer to rather different realms of social reality and the

problem of the former cannot be understood merely with reference to 'deficiencies' in scientific rationality. Rather, ideology is seen as essentially rooted in 'material social contradictions', serving to conceal those contradictions, and can only be dispelled by their 'practical resolution', not by science. However, science itself, being also rooted in material social conditions, can be subject to ideological penetration (ibid. p. 174-6).

Now, having rejected the positivist conception of ideology the problem essentially reduces to the consideration of the relative merits of the Marxist perspective as against the first position outlined above, viz. the 'positive meaning' of ideology. It can be argued that Larrain's discussion of this latter position is rather inadequate in the sense that it fails to accommodate the full implications of the hermeneutical tradition for the conception of scientific rationality. Defining ideology in such a way that there is basically no distinction between it and science fails firstly to do justice to the notion of science which emerges from the 'neo-Weberian' position which we have considered, and, secondly, to provide the conceptual machinery with which to accommodate the discrepancy between this notion of science and that which holds sway in our society. Thus, if we conceive of science as a system of value-contingent knowledge of varying cognitive value and connected to certain social interests, then the concept of ideology can usefully be reserved for the false presentation of such knowledge as objective and value free. From such a perspective it is possible for ideology to have 'negative meaning' without insisting that science can reveal a 'true' essence of social reality. Essentially, then, the concept of ideology can be seen as referring not to the actual characteristics of a particular body of knowledge but rather more to the attempt to portray that knowledge as embodying 'truth'.

Such a conception of ideology, although incorporating 'negative meaning', nevertheless stands somewhat at odds with certain elements of the Marxist conception. In terms of Marx's descriptive scheme of the structure of a social formation, ideology is seen as a 'superstructural' element, determined by the development of the mode and relations of production in the economic base or 'infrastructure'. As Lecourt (1975 p. 208) argues in endearing Marxist terminology:

"To determine ideology as an 'instance' in all social formations is in fact to accept the obligation... to think the constitution, functioning and function that instance as a material, historically determinate of instance in a complex social whole, itself historically determinate."

The 'historically determinate complex social whole' of relevance to the present discussion, then, is provided by an advanced capitalist, class-structured society comprising various class-based 'needs - interests' systems. Within this context:

"Ideologies function most centrally in the social process as the abstract generalisation of the practical outlook of social classes." (Shaw 1975 p. 65)

The basis of the relation of ideologies to the practical outlook of social classes lies, it is argued, in the latter's relationship to the means of production, their different roles in the social organisation of labour, their different ways of obtaining a share of social wealth and their different material interests (Cornforth 1976 p. 69).

Therefore, ideologies are based in human experience; they provide relatively coherent ensembles of representations, values and beliefs which translate peoples' 'real' relation to their conditions of existence into a partially imaginary relation, thus providing partial and distorted knowledge of the social structure, and 'inserting' agents into their practical activities supporting this structure (Poulantzas 1975 p. 206-7).

The capitalist mode of production is seen as producing a structure of social relations embodying the domination of capital over labour, or rather the domination of the capitalist over the working classes, and it is from this structure that the dominant ideology arises to serve the interests of the dominant capitalist classes. It achieves this end basically by distorting and concealing the 'reality' of exploitation and domination embodied in capitalist social relations to defuse discontent and opposition and ensure the maintenance of such social relations (Keat and Urry 1975 p. 178; Poulantzas 1975 p. 209; Shaw 1975 p. 64). It is not necessarily a question of the dominant classes intentionally and conspiratorially aiming to dominate ideologically; rather, the ideological distortions which serve their class interests are seen as being systematically generated from the material structure of social relations. Consequently, it is through the basic social institutions of capitalist society that the dominant ideology operates. These institutions influence the nature and content of daily life and experience, they are essentially organised and operate in the interests of the dominant classes; that is, the dominant classes 'wield institutional power' (cf. Parkin 1972 p. 84), while the dominant ideology justifies and facilitates their operation.

Therefore, within the Marxist framework ideology can be distinguished from science. Ideology is a form of consciousness, rooted in material social contradictions, which abstracts and fixes, 'surface' processes and phenomena or 'appearances', giving them an apparent but illusory autonomous existence, thus concealing the 'real' contradictory social relations of a capitalist society in the interests of the dominant classes. Science, on the other hand, should seek to reveal the 'real essence' of social relations by penetrating behind delusive surface appearances (Larrain 1979 p. 176-81). However, Marx argued that

science in a capitalist society is susceptible to ideological penetration by limiting enquiry to surface appearances thus being diverted from its potentially progressive role in unmasking the deceptions of ideology and liberating subordinate classes, to a repressive role in furthering the interests of the dominant classes (ibid. p. 181-7).

Within the Marxist tradition, however, there has developed something of a controversy in the theoretical discussion of the formation of ideology. This controversy relates basically to the question of the role and place of the 'historical subject' in the development of ideas and derives from the distinction between the early and later work of Marx. The 'historicist' school of Marxism, based on the earlier work, tends to see ideology essentially as 'false consciousness', as a "... problematic centred on the subject..." (Poulantzas 1975 p. 195-6), reflecting the tradition of German historicism and relating most closely to the hermeneutic approach. For example, Lukacs interprets ideology as the development of class-consciousness and argues that the hegemonic class in capitalist society develops a coherent 'world-view', in its attempt to achieve control over society, which can act as a 'cement' for the social formation. This world-view includes theories of economics, politics and society in a comprehensive ideological framework which also comprises a conception of what constitutes 'science' (Lukacs 1971 p. 46-80).

However, other Marxist theoreticians, perhaps best represented by Nicos Poulantzas (1975), criticise the historicist conception of ideology with reference to the later work of Marx which emphasises the idea of people's 'real' relations to their conditions of material existence - to nature, society, other people and to their own economic and political existence (ibid. p. 206-7). Poulantzas argues that the



elevation, in the 'Lukacsian problematic', of the conscious elaboration of a world-view by the dominant classes as a prerequisite for hegemony, places on that world-view the role of 'central determining instance' of the social whole and of the unity of the social formation. On the contrary, he argues, ideology should be seen as reflecting this unity and reconstituting it on an imaginary plane. The direct identification of class political organisation and consciousness with a world-view does not allow the 'ideological instance' a specific autonomy or independent theoretical status. Moreover, he insists that it results in a misleading interpretation of the relation between the dominant ideology and politically dominant classes due to the failure to incorporate the influence on such ideology of the political relation between the dominant and subordinate classes, and of 'historical class influences' (ibid. p. 202-5). Consequently, Poulantzas maintains that the starting point in the analysis of ideology must be the 'concrete structure of social relations' between various classes rather than the world-views of each class in isolation. In this context the dominant ideology can be seen to contain elements related to the conditions of existence of non-dominant classes and...

"...dominated classes necessarily experience their relation to their conditions of existence within the discourse of the dominant ideology." (ibid. p. 209).

It is not really appropriate to enter into the controversy between the 'historicist' and 'structuralist' schools of Marxism. From our perspective, it can be argued that Poulantzas under-states the role of the subject and provides a rather deterministic and abstract account which has, indeed, been criticised by Miliband (1972) as over-deterministic, inappropriate to a proper analysis of the 'dialectical relationships' in society, and lacking in 'concrete empirical analysis'. Lukacs' account, which indeed does relate the development of class-based world-

views to the concrete historical and social context, does appear to be rather more appropriate in its greater emphasis on the 'subjective' aspects of the process of production of social knowledge and on the social process of knowledge production under the influence of the interests and values of various classes and groups in society.

What we cannot accommodate from the Marxist account is the notion that science can provide an objective account of the 'real essence' of social phenomena. This is incompatible with the view of social scientific knowledge as thoroughly contingent upon value-frameworks defined in a particular socio-cultural context. From this point of view ideology does not refer to 'distortions' of a 'reality' which can be known through science because, it is argued, science cannot know a 'true social reality' independent of value-conditioned perceptions and judgements. The term 'distortion' is therefore inappropriate; rather all social knowledge is knowledge from a particular point of view and, consequently, inevitably has a particular 'moral colouring'. The concept of ideology refers, then, to the problem of a particular body of value-contingent social knowledge taking on the guise of 'true knowledge of social reality', of the embodied values receiving implicit, but illegitimate, accreditation, and of the social interests to which such values relate thereby being promoted at the expense of others.

#### 4.5 Conclusion

The discussion so far provides a basis for proceeding to the development of a rather more detailed conception of ideological social knowledge and this will be attempted in the next chapter. However, it is perhaps appropriate at this juncture to briefly indicate the nature of some of the questions to which such a conception must provide answers and to summarise in a preliminary way the implications of our position for the form of such answers. Firstly, our position can be briefly summarised. Based on the Weberian position I have argued that our knowledge of social processes and phenomena is contingent upon evaluative frameworks which are related to 'value-conditioned interest' defined in a particular socio-cultural context; all social knowledge arises 'from a particular point of view' and is a 'product of culture'. The existence of social stratification and differentiation produces conflicts between classes and groups in terms of both interests and 'general views on life and the universe'; consequently, different value-frameworks arise and these constitute the basis for conflicting interpretations of social phenomena.

Within this position the concept of 'value-freedom' cannot be upheld; it can be seen to be inconsistent with the relativistic notion of competing knowledges of social reality and can be shown to reduce to a question of 'scientific ethics' at which level there can be no guarantees of ethical 'neutrality'. Social knowledge comprises concepts and constructs which are necessarily 'morally tinted' and the process of its development is an essentially value-conditional enterprise guided by judgements, choices and decisions made in a particular social context. A particular body of social knowledge can therefore be seen as characterised by its 'value commitments' and such commitments become crucial to the question of 'rationality'. The tendency for those values

which are dominant in a society, and which are regarded as 'conventional', to become widely accepted as self-evident imperatives (rather than as contentious values) means that social knowledge derived from the viewpoint of such values will be promoted as apparently 'value-free' and, therefore, as the more 'rational'. As a result, a particular evaluative position is promoted in the name of 'value freedom', legitimised in the name of 'science', and elevated behind the guise of 'rationality' out of the realm of contention.

The concept of ideological knowledge, then, can be taken to refer to value-contingent social knowledge which is falsely portrayed as objective and free from the 'intrusion' of values. On this definition ideology does not refer to the nature of social knowledge as such; that is, it does not refer to the 'distortion' of social phenomena which can be contrasted with the penetration of the 'real nature' of such phenomena by 'science'. Rather, all social knowledge is morally slanted and the concept of ideology becomes relevant when such knowledge is falsely promoted as morally neutral.

From this perspective we can ask why the problem of ideology arises at all; that is: why is it necessary for particular bodies of social knowledge to be presented as objective, true or on 'firm cognitive ground'? This question was touched upon at the beginning of this chapter where it was suggested that social scientific knowledge performs an essential social function as an important basis for action by social agents and that this function imposes the requirement that knowledge so used must be defensible as 'reliable' in order to provide social action with credibility in this realm. It is possible to elaborate somewhat on this within our developing conception of social knowledge. For example, the institutions of the state constitute major users of what is

considered to be scientific knowledge of society and their purpose can be seen as the attempted solution of perceived social problems or, put another way, the attempt to overcome impediments to the achievement of some defined social condition. Whether 'problem solution' is achieved through changed material conditions or through the transformation of perception of given conditions from 'problematical' to 'acceptable', and whether action is actually based on scientific knowledge or on alignments of power politics, the appeal to a conception of action based on a true knowledge of society produces obvious legitimacy advantages. Firstly, it provides action with a legitimacy which it would not have if it were presented as the outcome of the balance of political power. Secondly, it could be argued that the admission of the value-contingency of social scientific knowledge would introduce the need for debate and discussion of the values which underlie different bodies of knowledge. This would produce a recognition of the contestability of value-stances which would tend to undermine the taken-for-granted nature of dominant values and the social group interests to which they relate.

From this point of view, then, the importance of the claim of the possibility of objective knowledge is readily appreciated. Indeed such an ideological claim can be seen as playing a central and fundamental role in advanced industrial and industrialising societies which rely heavily on the concept of 'material progress' and require a considerable degree of social organisation to achieve such progress. However, the form in which the claim manifests itself clearly varies with the nature of political and economic organisation. For example, in 'state socialist' societies, where explicit values are held to guide all social action, the later, materialistic, Marxist conceptions of science tend to dominate in which a true knowledge of society is presented as achievable from a perspective based upon the interests and values of a particular class.

Since it is held that such values are those which are explicitly embodied in the State, action by the State can be legitimated with reference to the claim of objective knowledge. However, in the Western capitalist societies no particular set of values is explicitly held to guide social action and positivistic conceptions of science tend to dominate in which a true knowledge of society is presented as achievable from a perspective which is free from the 'intrusion' of all value stances. In such societies it is claimed that the State acts impartially in the interests of all groups and therefore an important source of legitimation for state action is a conception of knowledge 'above' any influences from particular social interests.

If we accept the argument of the importance of the ideological claim of the possibility of objective knowledge the question then arises as to the nature of the particular bodies of knowledge which will be presented as representing the truth about society. Our perspective suggest a hypothesis, which can be developed in relation to the problem in <sup>Western</sup> advanced industrial societies. Such societies comprise several social classes and groups and this situation generates conflicts between social interests and different 'world-views' founded upon 'evaluative ideas'. The resulting value-stances and frameworks are not all equally weighted; in particular, it was argued earlier that certain values tend to become regarded as 'conventional' and 'dominant' and to be taken as 'self-evident', losing their overtly evaluative nature and taking on the guise of 'facts'. Social knowledge which is produced on the basis of such value-frameworks will therefore be seen as free from the intrusion of values - the fulfilment of the ideological claim of objective knowledge. It is such knowledge, then, which can be defined as constituting a 'dominant ideology'.

Therefore, it can be argued that what is presented as 'rational social knowledge' in a society is basically a function of the value-frameworks upon which social knowledge is founded; knowledge developed within the framework of conventionally accepted dominant values in society will tend to be regarded as 'rational'. Having put forward such a hypothesis an important question then arises as to the way in which social values and interests are 'embodied' in social knowledge and as to the nature of 'dominant values' and the 'dominant ideology' in our society. This brings us to the concern of the next chapter which will attempt to undertake an examination of the process of social knowledge development, of bodies of social knowledge which are conventionally regarded as 'rational' in our society, and of the nature of the evaluative frameworks which they embody.

## Chapter 5: Ideological Knowledge, Social Problems and the State

### 5.1 Introduction

The conclusions from the discussion of the previous chapter provide a broad outline of a conception of ideological social knowledge. My intention in this chapter is to elaborate on and develop this position as a hypothetical descriptive schema - an attempt to provide a representation of social scientific knowledge as it is constituted in our society as a basis for a fuller understanding of controversies over public policy issues. Within the framework adopted certain issues are of particular importance and warrant more detailed attention. My major concern will be to examine the nature of ideological knowledge and its relationship with the socio-historical context in which it is developed and used, and in this examination particular emphasis will be placed upon the role of a 'practical' requirement to solve problems and contradictions which arise in society. In this way I hope to be able to present a conception which embodies a coherent integration of the issues raised in the previous chapters.



## 5.2 Ideological Knowledge and Social Problems

The problem of the relationship between the form of development of scientific knowledge and the social and historical context in which such development takes place has long been the focus of the sociology of knowledge, a field of enquiry that originated in Germany in the 1920s from the concern to develop scientific historical scholarship (Berger and Luckmann 1979 p. 16-17). The viability of this field of enquiry depends essentially upon its ability to discover general causal or functional relationships between social structures and scientific ideas and this has been a central concern in the work of such social theorists as Scheler, Marx, Dilthey and Mannheim (ibid. p. 17-23). However, it has been argued that the sociology of knowledge is characterised more by controversy over alternative theoretical approaches than by conclusive evidence of the nature of such relationships:

"Whether we look to Marx, Mannheim, Merton or to any of the other leading sociological theorists, we are left in the dark when it comes to the specification of a general mechanism for explaining the connection between social situation and ideological commitment in the scientific or philosophical sphere." (Laudan 1977 p. 219)

Now, it may be that such a critical stance overemphasises the degree to which it is possible to derive 'conclusive demonstrations' of the operation of what are likely to be rather subtle and general 'influences', rather than discrete 'mechanisms'. Nevertheless, the force of the criticism undoubtedly remains. However, this does not necessarily imply acceptance of the argument that scientific knowledge is unaffected by social and political factors as propounded by the positivistic approaches to the problem. As we have seen, the traditional orthodox sociological perspective in science argues that scientific knowledge

provides an objective account of the external world independently of the social and cultural 'position' of scientists. This is seen as achieved through the application of socially invariant 'scientific' norms and values, institutionalised in the form of rules which govern scientists' behaviour and choice. The values conventionally emphasised are those of, for example, 'universalism', 'disinterestedness', 'criticism', 'emotional neutrality' and 'humility' and it is argued that the scientific community is organised in such a way as to ensure that these values are minimally distorted by pressures of a personal or social nature (cf. Mulkay 1979).

In previous chapters I have attempted to demonstrate the untenability of this position and elaborate the implications of the 'neo-Kuhnian' and 'neo-Weberian' critiques. Thus, Kuhn argued that scientific values cannot be given and universal but rather must be contingently variable between scientific communities and over time and must influence choices, judgements and decisions in complex ways depending on the social context in which knowledge development takes place (Kuhn 1977 Ch. 13). Kuhn's arguments have therefore pointed the way towards a conception of social science as an enterprise which is thoroughly contingent upon institutional, social and political processes. Social scientists within a research community are influenced by values whose meaning is established in interpretive fashion with reference to the prevailing paradigm and to their social and cultural setting. In the development of knowledge, therefore, judgements concerning, for example, what constitute important problems and significant solutions emerge from a social process "... inextricably bound up with the particular cognitive, evaluative and power political structures of the discipline" (Schuster 1979 p. 304). We have seen, moreover, that such a perspective is consistent with an interpretation of Weber's arguments to the effect

that knowledge of social phenomena is necessarily contingent upon evaluative frameworks which are related to 'value-conditioned interests' defined in a particular social context; all social knowledge is therefore 'morally tinted' arising from a particular social perspective.

However, having arrived at such a position we are still faced with the problem of specifying the precise way in which the development of social scientific knowledge in our society is influenced by the particular social, cultural and political characteristics of that society. If we are to progress in the development of our conception of ideological knowledge we must be able to say something about the way in which social interests and values are embodied in social knowledge and to provide a possible explanation of the emergence of what we have defined as a 'dominant ideology'.

At the most general level it is necessary to conceive of the process of development of social knowledge not as an isolated mental process taking place in a realm of pure intellect 'above' the influence of social and political factors, but rather as a process firmly rooted in human social activity and in the socially-structured relationships between people which arise from such activity. More specifically, we can argue that our knowledge about the world develops primarily through the continuous attempt to confront and solve problems which arise (and are perceived as significant) concerning the relationships between a social entity and its natural environment and between people in different social positions within that entity. If we conceive of human existence as developing under the influence of the natural environment, the prevailing level of technology and the means to produce social wealth, and the prevailing institutional framework (e.g. the structure of access to 'life opportunities', the distribution of wealth and power, the existing stock

of knowledge etc) then problems arise, and are perceived, within this framework of social and material constraints, and with their attempted solution knowledge about this 'constrained world' develops. That which becomes encoded as scientific knowledge therefore depends fundamentally upon the terms in which the 'important' and 'significant' problems for a society are perceived and defined. Such 'terms' will vary between different social groups occupying different locations in the social and institutional structure; different groups with different interests and values see social problems in different ways. Therefore, what becomes accepted as viable knowledge is contingent upon the social perspective from which 'relevant' problems are defined and from which attempted solutions are derived.

It is apparent, then, from this perspective, that the pace and direction of social research is heavily conditioned by particular interpretations and perceptions of what are 'important' problems. Since the investigation of such problems requires their specification as 'intellectually constructed objects' (cf. Ravetz 1971) their definition in a particular socio-historical context depends not only on the material nature of the contradictions which produce them but also, and more importantly, on existing frameworks of knowledge which provide the concepts and language for the definition. (Ravetz op. cit. p. 340-1) argues that:

"... the statement of the goal of the problem, as well as those of the controlling judgements, presupposes a social and moral philosophy. This may be implicit and informal, and may seem obvious common sense to its proponents. But it is an ideology, a universe of reality and value, which itself is incapable of simple testing and scientific control..... The work of investigating and solving the practical problem will necessarily be done within the framework of that ideology in whose objects the problem is conceived and first assessed."

Now, to the extent that 'conventional' and 'normal' interpretations and definitions of problems are provided by the dominant 'universe of reality and value' in society there will arise an in-built tendency towards the strengthening of such knowledge frameworks through the process of problem investigation. The ability to 'solve' problems can be seen as an important factor in the maintenance of the legitimacy of a particular framework of social knowledge. However, the actual achievement of solutions is highly problematical; given the essential nature of practical social problems an 'objective' solution is not possible. Therefore, it is possible to conceive of 'solutions' as comprising two components. Firstly, some progress can be made towards a circumscribed understanding of the situation, on the basis of cognitive elements in the knowledge framework, and changes made to the material conditions which produce the problem as perceived. But this partial process must be supplemented by a 'rationalisation' of the problem in order to reduce its perceived threat to society; this can be achieved by legitimising elements of the situation and by presenting the impression that the contradiction can be resolved within the knowledge framework (cf. Ravetz op. cit. p. 397-8). The presentation of social knowledge as objectively true or at least 'cognitively well-founded' can be seen as an important means to the achievement of such an impression.

This conception of ideological social knowledge is rather abstract and generalised and requires 'fleshing out' somewhat with reference to a more practical account of the process of social knowledge development. It is appropriate, therefore, to look briefly at some aspects of the evolution of particular bodies of social knowledge in our society. The examples chosen are sociological and economic theory. Therborn (1976), for example, provides an analysis of the development of sociological thought in relation to changes in the socio-economic context of

nineteenth century Europe. He argues that sociology developed during this period in response to the problem of political reconstruction, emerging first in France after the Revolution as an expression of a new awareness of social problems promoted by the changes caused by the Revolution (ibid. p. 128, 210). Specifically, Saint-Simon and Comte were concerned with the problem of the transition to a new industrial society, and Comte in particular promoted the view that modern society should be studied by the methods of observation and analysis pioneered in the positive natural sciences (cf. above Chapter 3). Indeed, he is regarded as the founder of positivist social science, presenting the 'science of society' based on the empirical analysis of what is, and deserting the earlier philosophical perspectives on what ought to be. On the basis of such scientific analysis the new 'useful' classes in society (workers and employers) could exercise political power to achieve the rational society (ibid. p. 211-5; Rex 1973 p. 9).

In England, where the Bourgeoise Revolution had occurred much earlier, the nineteenth century was dominated by the process of rapid capitalist industrialisation and social thought was dominated by the rise of economics. Consequently, Spencer's sociology was developed within the framework of classical economics and was based on the work of Adam Smith and Jeremy Bentham which was concerned to rationalise the capitalist economic system by identifying progress with the free operation of market forces and self-seeking behaviour by free and rational individuals (ibid. p. 91-3). Therborn argues, therefore, that all the early sociologists displayed a fundamental attachment to the emerging capitalist society in rationalising its developing problems and defending it against reactionary feudal forces as well as revolutionary socialist ones (op. cit. p. 219-24).

In the late nineteenth century the orientation of British sociology changed in response to increasing concern with the social problems caused by the rapid development of capitalist industrialisation which began to present threats to social stability and to continued capital accumulation. But the response was in the form of what Therborn calls an 'Administrative Sociology' based upon empirical investigation of the social conditions of workers and the poor and framing recommendations for social policy to improve these conditions. (op. cit. p. 230). The work of Booth, Rowntree and the Webbs tended to conceive of the problem in terms of 'maladministration' rather than in terms of the underlying structure of power and wealth in society; it did not question the fundamental basis of the society which produced such problems nor challenge the interests of the dominant classes. Even Fabian Sociology was, Therborn argues, "...drenched in the established assumptions of the prevailing social order" (op. cit. p. 235); adhering to the basic principles of marginalist economics it represented "... a theory of economic reconstruction developed in opposition to the proletarian revolution." (ibid. p. 237).

Consequently, it can be argued that the broad ideological framework of mainstream sociological thought developed in relation to emerging problems of capitalist development as they were interpreted and defined from the perspective of dominant class interests. The work, for example, of the 'social reformers' of late nineteenth century Britain can be seen as producing solutions to the problems-as-perceived partly on the basis of legitimations of the prevailing social order (e.g. a 'concerned' State and reassurance that the problems could and would be alleviated) and partly on the basis of material changes to the living and working conditions of the poor deriving from the analytical findings of the developing sociological knowledge.

A similar picture emerges from a study of the evolution of economic thought in Britain as it underwent the process of capitalist economic development during the eighteenth and nineteenth centuries. With the rise of merchant capitalism in the seventeenth century based upon trade and commerce there had been a substantial increase in the degree of government intervention in the economy, particularly in the sphere of international trade in order to secure profits for trading companies, increase government revenues and ensure imports of precious metals (Hunt 1972 p. 15-28). But the changing nature of the economic system with the development of small-scale industrial capitalism provided the basis for the emergence of new economic ideologies which came increasingly into conflict with prevailing modes of thought. The 'Christian Paternalist Ethic' had promoted the idea that the State had an obligation to promote general welfare and protect the poor and needy (ibid. p. 28-39). However, the ascendant market capitalist system was based on individualism and self-seeking behaviour contradicting this ethic; Protestantism and the new philosophies of 'possessive individualism', developed, for example, in the theories of Hobbes and Locke, provided the necessary basis for a new ideology to justify individualism, profit-seeking and minimum government intervention in market processes. (ibid; Macpherson 1962).

With the rapid progress of capitalist industrialisation in the late eighteenth and the nineteenth centuries a new individualistic world-view of 'classic liberalism' matured into the dominant ideology of capitalist society (Macpherson 1972 p. 19-21; Hunt op. cit. p. 41-4). A central feature of the ideology was provided by Bentham's utilitarianism which combined the philosophies of individual self-interest with an hedonistic view of human motivation in a justification of the liberal capitalist economy on the grounds that it promoted the maximisation of aggregate



utilities through the market, if the latter was left free from state interference to determine the allocation of material product amongst individuals (Macpherson 1972 op. cit.). The economic aspects of this ideology were further developed by Adam Smith who argued that the pursuit of individual self-interest in a context of free market competition would produce the best use of resources and maximise the welfare of society as a whole. The free market, liberated from 'unnecessary' government interference, would produce continued social and economic progress through a mutually reinforcing division of labour which would increase productivity and profits and promote capital accumulation (Hunt op. cit. p. 47-50).

The political component of this ideology, concerning the role of the State in capitalist society, was therefore of fundamental importance. Considerable attention was focussed on the problem of adapting the State to the perceived needs of the capitalist economic system. Smith's arguments, together with those of Thomas Paine, resulted in a conventional view of government as a 'necessary evil' but this was translated in practice as a justification for the elimination of government 'interference' where it obstructed profit-making and capitalist accumulation, but the retention of 'intervention' where it promoted such ends. During the nineteenth century, therefore, 'legitimate' government functions related to, for example, fiscal policy, protection of the country from 'external threat' (commonly reducing to the protection and extension of foreign markets), the maintenance of law and order (mainly involving the protection of private property, the enforcement of labour contracts and the suppression of workers' revolts and the labour movement), and, finally, the development of public works and maintenance of institutions necessary to profitable production and exchange (e.g. stable currency, communications, education)

(ibid. p. 52-4; Therborn op. cit. p. 84-6).

During the latter part of the nineteenth century the process of capitalist economic development was characterised by the increasing scale of production and the increasing concentration of capital and income in fewer hands. Also, the rapid growth of industry had resulted in increasing concern about scarcity of raw materials for future growth. Moreover, with increasing industrial concentration and concern about poverty and poor living and working conditions, the strength of workers' movements was growing which led to fears, amongst bourgeoisie and upper classes, of possible conflict, fears which were exacerbated by the work of Marx and events in Paris in 1870. The work of 'Classical' economists (e.g. Ricardo) was focussed on the circumstances and conditions of production and the problem of the distribution of wealth between social classes thus highlighting the problems of capitalist development. It was in this context that the so-called 'marginalist revolution' in economic thought occurred pioneered mainly by Jevons, Walras and Marshall and members of the Austrian School (e.g. Böhm - Bawerk) (Dobb 1973 Chapter 7; Meed 1972; Robinson and Eatwell 1973 Chapter 3).

The main arguments of the neoclassical school concentrated on the position of the individual and on the process of commodity exchange, with the theory of relative prices of commodities based on Bentham's concept of utility. The marginal utility theory of value was based on mental relations between individuals and commodities rather than social relations between humans in the production of commodities; the emphasis upon the capacity of commodities to satisfy the subjective wants and desires of consumers strengthened the individualist bias of the dominant ideology of capitalist society (Dobb op. cit. p. 167-8;

Meek op. cit. p. 90). The theory presented the distribution of income as an outcome of the market exchange process; as a natural derivative of a process of exchange which maximised utility and gave everyone what their contribution was worth. Consequently, the question of the distribution of wealth and income between social classes was removed from explicit consideration; such distribution was a product of 'natural laws' and could not be rationally discussed outside the framework of such laws (Dobb op. cit. p. 169-72; Macpherson 1972 p. 23). Also the theory of marginal utility, by showing how 'optimum' allocations of resources were achieved in free market competitive conditions, provided a justification for minimum interference of government, strengthening the tradition deriving from Adam Smith. Finally, by promoting the mechanical analogy as the appropriate methodology for the new economics Jevons encouraged a preoccupation with static equilibrium conditions thus neglecting the process of change and implying the immutability of the existing nature of capitalist society (Dobb op. cit. p. 172-5).

These tendencies, therefore, strengthened the ideological nature of economic thought as a response to the emerging problems of capitalist economic development as they were perceived from an essentially 'bourgeoise' class perspective. Therborn (op. cit.) makes this point forcefully arguing that the scientific community concerned in the development of economic thought was firmly rooted in such a perspective; many economists had business and political careers providing a direct link between theory and a practical context which inevitably provided 'definitions' of economic experience (ibid. p. 89-92). Therborn concludes that:

"....marginalism, like classical economics, was certainly the product of a mainly bourgeoisie intelligentsia.... None of the prominent representatives of the new economic doctrine was associated with the working class movement. On the contrary, many were outspoken critics of it, above all its revolutionary and Marxist tendencies...." (ibid. p. 93-4).

Of course, this is not to argue that such economists consciously developed theories to justify the new capitalist order. Rather, it is to suggest that the developing capitalist economy presented problems which were interpreted by the intellectual community in accordance with their class-based experiences and interests and that the process of formulating theories and hypotheses to solve these perceived problems was inevitably influenced by evaluative perspectives, the meaning of which gained their interpretations in relation to 'life-experiences' and world views derived from a context of relatively wealthy and privileged social existence in business, political and intellectual circles.

The 'Keynesian Revolution' in economic thought in the 1930s illustrates a similar overall pattern. Keynes' 'General Theory' emerged as a response to the severe world economic crisis of the late 1920s and early 1930s but from a perspective which was concerned to make adjustments to the capitalist system in order to ensure its preservation. Keynes accepted the general framework provided by the neoclassical theory of value and distribution which, therefore, heavily influenced his perception of the problem and the nature of the questions he asked (Dobb 1973 p. 214-5). Keynes' solution permitted the preservation of the broad system of capitalist enterprise and was therefore seen as 'legitimate' and 'scientific'. Indeed, its strength lay in the fact that it could be interpreted as providing benefits to everyone; to workers through the achievement of full employment; to capitalists through public investment in 'support infrastructure'; and to

government through increased legitimation of its activities. It is notable that other approaches to the problem, such as those of Kalecki and Hobson, were not seen as legitimate because they were much closer to a Marxist analysis and, consequently, presented policy implications which were threatening to the basic structure of the capitalist economic system (e.g. Hobson proposed equality in the distribution of wealth). On the other hand, Keynes had a well-known aversion to socialist ideas (ibid.).

Having indicated the broad outline of a conception of social knowledge development in relation to dominant perspectives on the nature of social problems, it is possible to further elaborate such a conception by referring to ideas which have developed out of the German historicist tradition and are expressed in, for example, hermeneutics, the phenomenologist school, the early perspectives of Marx and the work of the 'Critical Theorists'. Two sources of such ideas appropriate to the present discussion are firstly, the work of Berger and Luckmann and secondly that of Jürgen Habermas.

Berger and Luckmann (1979) analyse the process of development of conceptions of reality as 'social constructions' and conceive of social theories as legitimations of particular constructions of reality. They therefore provide a possible broad problematic as a rationale for the development of social knowledge. Berger and Luckmann argue that human activity in any social and cultural context is subject to an artificial ordering which provides necessary direction and stability (ibid. p. 65-70). Such 'habitualisation' of activity, which also allows specialisation, becomes encoded into institutions which essentially serve to maintain and transmit social order and stability; institutions control human conduct by channeling it according to pre-defined patterns

(i.e. prior to explicit control mechanisms) (ibid. p. 70-73).

However, in order to succeed in this role, institutions must claim authority for their definitions of society and social conduct; that is, they must be 'legitimised' in terms of an interpretation of their 'social meaning' which can be maintained as an orthodoxy. Therefore, legitimation is achieved via social knowledge which embodies 'socially articulated and shared universes of meaning', presents institutions as natural entities rather than human constructs, and provides the framework in terms of which the social world is perceived and constructed (ibid. p. 79-84):

"What is to be taken for granted as knowledge in the society comes to be coextensive with the knowable, or at any rate provides the framework within which anything not yet known will come to be known in the future..... knowledge in this sense, is at the heart of the fundamental dialectic of society.... It objectifies this world through language and the cognitive apparatus based on language, that is it orders it into objects to be apprehended as reality." (ibid. p. 83-4)

Legitimation, then, requires the 'explanation' and the 'justification' of the institutional order; the provision of "... a protective cover of both cognitive and normative interpretation..." (ibid. p. 79) from which higher-order integrative meaning can be derived. Berger and Luckmann emphasise this dual nature of legitimation:

"Legitimation 'explains' the institutional order by ascribing cognitive validity to its objectivated meanings. Legitimation justifies the institutional order by giving a normative dignity to its practical imperatives." (ibid. p. 111)

Moreover, the process of legitimation takes place at various different 'levels' and these cognitive and normative components can be seen as playing different roles at each level. At the highest level there arise 'symbolic universes' which are defined as "...bodies of theoretical

tradition that integrate different provinces of meaning and encompass the institutional order in a symbolic totality..." (ibid. p. 113); in other words these are all-embracing frames of reference or world-views (in Weberian terms - 'general views of life and the universe') which integrate subjective experiences within an 'overarching universe of meaning' or 'put everything in its right place' (ibid p. 113-21).

Since such symbolic universes are rather far removed from the 'pragmatic sphere of everyday life', they can be seen as comprising a very strong normative component.

Within the framework of symbolic universes lower levels of legitimation of the institutional order are achieved by more specific bodies of theoretical knowledge more directly related to social action and therefore having a stronger cognitive component (ibid. p. 112-3).

In particular, social scientific knowledge can be seen as playing an important role in supporting and legitimising higher level symbolic universes; that is, such knowledge constitutes a 'conceptual machinery of universe-maintenance', playing an important role in the maintenance and transmission of institutional and social order (ibid. p. 127-30). Indeed, modern science is seen as a very advanced form of legitimacy framework, an "...extreme step.... in the secularisation and sophistication of universe-maintenance..." (ibid. p. 130) but nevertheless a framework which systematises both cognitive and normative components of legitimation as embodied in the symbolic universe that it serves to maintain (ibid. p. 127).

The situation is, however, complicated by processes of social segmentation. The division of labour and production of an economic surplus permits the development of specialised activities and roles which in turn results in specialisation and segmentation of knowledge

in terms of which the segmented institutional order is understood and legitimised (ibid. p. 89-102; 134-5). Therefore, social segmentation and structuring produces a problem of "...socially segregated sub-universes of meaning..." (ibid. p. 102) associated with role-specific knowledge. These 'sub-universes' provide different perspectives on society which are related to the concrete social interests of the groups which are their 'carriers' and which produce the meanings in question. Conflict between such groups is then translated into conflict between rival 'sub-universes' or bodies of knowledge (ibid. p. 102-4). As Berger and Luckmann state:

"Conflict or competition may exist between such groups. On the simplest level, there may be conflict over the allocation of surplus resources to the specialists in question, for example, over exemption from productive labour..... Such social conflicts are readily translated into conflicts between rival schools of thought, each seeking to establish itself and to discredit if not liquidate the competitive body of knowledge.....In advanced industrial societies, with their immense economic surplus allowing large numbers of individuals to devote themselves full-time to even the obscurest pursuits, pluralistic competition between sub-universes of meaning of every conceivable sort becomes the normal state of affairs." (ibid. p. 103)

Moreover, because such bodies of knowledge are removed from the 'concrete experience of everyday life' and comprise important normative components, conflict between them cannot be settled on an empirical basis; knowledge is validated by social rather than empirical support; theories are convincing because they become taken-for-granted:

"... there will always be a social-structural base for competition between rival definitions of reality and... the outcome of the rivalry will be affected, if not always determined outright, by the development of this base.", (ibid. p. 137)

Therefore, the validity of a particular definition of social reality will be decided in terms of its applicability to the social interests



of the group that is its 'carrier'; groups require solidarity and bodies of knowledge related to their interests are important in generating solidarity and promoting those interests in relation to the wider symbolic universe (ibid. p. 137-42).

Berger and Luckmann's analysis provides a broad framework within which it is possible to develop our conception of ideological social knowledge. The broad social problem of the maintenance and transmission of social order and stability requires the legitimation of the institutional order via an 'official' definition of 'social and institutional reality' which must be 'made to stick' (cf. ibid. p. 126). This is partly a question of power but in modern 'democratic pluralist' societies other forms of legitimation are important, in particular the acceptance of certain bodies of knowledge as taken-for-granted or as encompassing the 'truth' about society. Since certain social interests and values come to be regarded as 'orthodox' and 'conventional' (and, indeed, even taken-for-granted as self-evident) the definition of reality relating to such interests and values will become dominant and must be presented as a 'true' definition in order to be 'made to stick'. From this perspective, therefore, the concealment of the inherently value-conditioned nature of social scientific knowledge behind a facade of objectivity can be seen as essential to its power as a conceptual machinery supporting the maintenance of our dominant symbolic universe or world-view and therefore legitimating the existing institutional order.

A further perspective on the relationship between the development of our knowledge about the social world and the problems of human social existence is provided by the arguments of Jürgen Habermas which were outlined in Chapter 2 (cf. above p.102-4). To re-cap briefly, Habermas argues that scientific knowledge is formed within a framework which

develops through the relationship between human beings and their natural environment as manifested in the labour process. Human existence is inherently action-oriented and human behaviour involves a system of instrumental, feedback-monitored action. Our knowledge of the world therefore arises to guide our purposive-rational behaviour in a context of an overall human interest in technical control over our environment. In advanced industrial society technical control over nature has reached a high level of sophistication through the knowledge produced by the positivist 'empirical analytic' sciences and the administration of human beings has been continually refined through the positivist social sciences.

Habermas' arguments provide a high-level conception of a broad problematic which determines the development of ideological social knowledge, mainly, indeed, in terms of its underlying epistemological or methodological character rather than the substantive content of its theoretical systems. The theme is developed by Dreitzel (1972):

"Today the production and distribution of scientific and scholarly knowledge are institutionalised according to the functional imperatives of industrialised social systems. The process of research can no longer be separated from the utilisation of the products of research." (ibid. p. 167)

He argues that the social function of social science research is determined not only by the problem area under study but even more so by the methodological approach used. Most social science in our society is....

"...dedicated to the positivistic program of a unified behavioural science, a programme which, in the more refined versions of behaviourism, is methodologically oriented towards the sciences, and, especially in the general theory of action, conceptually oriented toward a bureaucratised society's understanding of rationality." (ibid. p. 167-8).

Empirical positivistic research, then, is oriented towards the production of social techniques in relation to vested interests' perceptions of the problems of 'exploitation of the labor force' and 'the maintenance of mass loyalty'. Knowledge produced by the theories of action functions as an ideology which contributes to "...establishing and maintaining the technocratic consciousness of the educated middle classes..." by obscuring relations of production and their historical context (ibid. p. 168-9).

This line of argument is also pursued by Fay (1975). The progress and cultural support of science in modern industrial society is linked to the problem of ensuring the continued expansion in the forces of production and extending the administration of all facets of social life (ibid. p. 44-6):

"It is thus no accident that a positivist conception of social science which was tied to an engineering notion of theory and practice gained credence as industrial society developed, for it was just such a conception which this society required for its continued existence. The idea of a positivist social science emerging into a policy science is to advanced industrial society what liberal economic theory was to the early forms of laissez-faire capitalism. A positivist social science, technical control, and industrialism: these are mutually reinforcing features of modern social age." (ibid. p. 47)

Of course, such arguments face the danger of succumbing to a form of functionalism which is not particularly enlightening as a means to understanding the relationship between scientific knowledge and its socio-historical context. Although it is difficult to derive any 'firm evidence' as to the nature of the determinants or influences at work in this relationship the adoption of a functionalist approach can often be an 'easy option' which circumscribes our ability to develop our understanding of social systems. Nevertheless, there do appear to be reasonable grounds for relating the development, in particular, of 'mainstream' conceptions of social scientific knowledge to the

attempted solution of problems which arise in the course of social development within an interpretive framework established in relation to the social experiences and interests of dominant classes and groups. In order, therefore, to provide a basis for a conception of the current nature of 'orthodox' ideological social knowledge, or of a 'dominant ideology', it is necessary to examine in rather more detail the characteristics of the 'problem-interpretations' which can be seen as predominantly influencing the process of social knowledge production in advanced capitalist society.

Here we must move towards an analysis of the power political correlates of the process of knowledge production and begin to examine the role of the institutions of the state in this process. The decisions and judgements made by social scientists concerning 'relevant' and 'important' problems to be investigated in research and the appropriate methodological approach to such investigations are made within the framework of existing paradigms and subject to the influence of the institutions of the state which have an impact on the determination of research priorities. Research within an 'orthodox paradigm' will tend to be self-perpetuating with problem-perception and choice of methodology influencing the nature of the resulting additions to the conceptual framework of the paradigm. The existence of an 'orthodox paradigm' within a wider dominant ideology tends to ensure continued concern with problems defined and interpreted in an 'orthodox' way. External control of the process derives primarily from institutions of the State which provide 'official' interpretations of what are priority problem areas and which control the allocation of research funding. Social interests and values can be seen as underlying the whole process being reflected both in the institutional forms of the state and in the interpretations, judgements and decisions which are embodied in the process of social knowledge production.

Moreover, in a general sense much social scientific knowledge is concerned with areas of state activity in society, for example, management of the economy, the maintenance of health, social welfare and law and order, the provision of education etc. Consequently, the development of such knowledge is closely related to the needs of the State to carry out its 'necessary functions' and we need a theory of the role of the state in capitalist society in order to understand the rationale of the process of production of social scientific knowledge.

### 5.3 Social Problems and the State

As a starting point in the analysis of the State it is perhaps useful to consider critically the theoretical positions which derive from the Marxist tradition. Indeed, within this tradition there are quite substantial differences between various theoretical approaches to the relationship between the capitalist state and society. However, the different views tend to be unified through a common concern with specific modes of production, their conditions of existence and their effects on social formations (Jessop 1977 p. 369). The primary orientation of the Marxist approach is towards an analysis of the role of the State in relation to the economic system - particularly in relation to the process of capital accumulation. Marx himself did not provide a specific, rigorous theoretical analysis of the capitalist state emphasising instead the ability of the capitalist economy to regulate itself without state intervention, and to generate spontaneously a particular form of economic development (Rowthorn 1977 p. 327). However, Marx conceived of this self-regulation not as an harmonious process (as presented in neo-classical economic theory) but rather as a very irregular succession of economic booms and crises. It is appropriate, therefore, to initially briefly outline the theory relating to the nature and causes of economic crises in the capitalist economy.

Basically, the capitalist economic system is seen to proceed through capital accumulation - through the accumulation of surplus value extracted from labour - which is, in turn, used to reproduce, extend and develop capitalist production (Grahl 1979Ap. 76). However, the profitable investment of accumulated capital is limited, on the one hand, by the growth in the market for consumers' goods (i.e. in workers' wages) and, on the other, by the growth in the availability of

exploitable labour power, both relative to the growth in production capacity (ibid. p. 77-8). Both of these factors, it is argued, tend to squeeze the rate of profit which leads to a relative over-accumulation of capital since surplus cannot be invested without reduction in the rate of profit. As expansion slackens, therefore, industries producing investment goods can no longer sell their products and a crisis occurs (ibid; Rowthorn op. cit. p. 328).

Two main types of processes then operate in the resulting crisis to restore the rate of profit and re-establish the necessary conditions for profitable expansion. The first type of process acts directly to increase profits at the expense of wages (i.e. increasing absolute surplus value) and is manifested particularly in unemployment. The second type of process operates to devalue large fractions of obsolete capital equipment in order to prepare the way for substantial increases in labour productivity (i.e. increasing relative surplus value) (Grahl op. cit. p. 78-9; Rowthorn op. cit. p. 328; Harris 1977 p. 119). Economic crises are therefore seen as both the product of contradictions within the capitalist mode of production, and also the basic means by which they are temporarily and partially overcome; they are therefore seen as intrinsic and necessary to capitalism:

"In terms of the basic categories of historical materialism, crises are an expression of the growing contradictions of the capitalist mode of production, between its increasingly obsolete production relations, based on private control, and the increasingly social productive forces that develop within it. Crises are both the concrete result of these contradictions and the basic means by which they are temporarily and partially overcome. Crises thus bring about an adaptation of capitalist production relations to a given level of development of production."  
(Grahl op. cit. p. 75).

As capitalism has developed, however, it has become increasingly clear that it cannot be a self-regulatory system and this is manifested in increasing intervention by the State in the process of capital accumulation and in the management of economic crises. Yet only relatively recently have Marxist theorists begun to confront the question of the different forms of the capitalist state and their adequacy to continued capital accumulation in different situations. In general terms, the traditional Marxist view of the capitalist state is to see it essentially as the coercive instrument of the ruling classes. Since the capitalist class holds the dominant power in capitalist society, it exercises that power to maintain the social and political institutions which function in its favour; consequently, the state basically operates in the interests of the dominant class (cf. Miliband 1973 p. 7; Edwards and MacEwan 1971 p. 19-20; Dear and Clark 1978 p. 176-7). This traditional view is reflected, for example, in the current theories of the 'State Monopoly Capitalist' school which emphasises state intervention in the workings of the modern capitalist economy on behalf of monopoly capital to maintain the dynamics of capital accumulation and offset the tendency towards a falling rate of profit. The state is therefore seen essentially as an instrument of the dominant monopolies, reflected in the class background and class affiliation of the personnel of the state, the formulation and implementation of state policy, and the dominance of monopoly capital in, for example, the education system and mass media (CPGB 1978 p. 6-10; Jessop op. cit. p.360-1).

However, such a conception is really rather too simplistic failing, in Miliband's words, to confront "...the concrete socioeconomic and political and cultural reality of actual capitalist societies..." (op. cit. p.8). Now, although one can argue with the use of 'reality' as a standard for criticism, the limits of this approach are indicated



simply in an inability to explain how the state can remain an instrument of class rule when the dominant class patently has no immediate control over it. In an attempt to overcome such problems the theory of the capitalist state has been more recently advanced, particularly by Poulantzas within the French structuralist school based on the Althusserian brand of Marxism. Poulantzas' arguments are highly abstract and complex but I shall attempt a brief outline.

Basically, Poulantzas (1975A, 1975B) is primarily concerned to refute the view of the 'state monopoly capitalist' school of the state as an instrument of monopoly capital. The capitalist state, he argues, cannot be seen as a passive tool in the hands of any class or fraction; rather, it is a complex 'social relation' or, more specifically, a condensation of class power relations. Social classes should not be seen simply as economic forces existing outside and independently of the state and capable of manipulating it since their political influence partly depends on the institutional structure of the state and on the effects of state power. The state apparatuses do not possess 'power' of their own but reflect and concentrate class relations while at the same time playing a constitutive role in the class struggle. The state represents the political interests of the dominant class 'power bloc', constituting their political power centre and the organising agent of their political struggle. But the relationship between the state and this 'power bloc' is not one of identification or manipulation; the state maintains a 'relative autonomy' in relation to the dominant classes (op. cit. 1975A p. 190-3; 1975B p. 26, 157-61).

The fundamental functions of the state, therefore, are seen by Poulantzas to relate to the field of the political class struggle. Specifically, the state has the function of maintaining 'social

cohesion' - maintaining order and unity in the social formation within which contradictions condense into political class domination. The state plays the role of political unifier of the dominant power bloc concentrating and sanctioning its hegemony and therefore reproducing social class relations. Within this global political role of social reproduction, economic and ideological functions play important parts. The economic function may be dominant in certain capitalist social formations involving the management of economic crises and the promotion of capital accumulation as the major problematic in the reproduction of capitalist social relations (op. cit. 1975A p. 44-55; 1975B p. 27-34, 165-72). Finally, social cohesion through political domination requires a dominant ideology which attempts to impose a 'way of life' on society through which the state can be experienced as representing society's 'general interest', as a neutral instance representing the interests of all equal and free individuals, thus concealing the nature of political power embodied in the state (op. cit. 1975A p. 188-9, 214-6; 1975B p. 173).

Apart from problems of dogmatism and scholastic obscurity, perhaps the major criticism of Poulantzas' approach relates to its functionalism. Rejecting the notion that the state is under the direct control of capitalists and dismissing the 'historicist' (Lukacsian) school of Marxism, the formulation must rely on a functionalist account: the state is capitalist because that is the nature of the society in which it exists. Such an account is not helpful in explaining how political actors are forced to act in a way compatible with the general interests of the dominant classes; nor can it easily accommodate the view of the state as a system of political domination the institutional form of which may be more or less adequate to securing the various requirements of capital

accumulation in different situations (Crouch 1979 p. 26; Jessop op. cit). A further problem resides in the treatment of the State's response to non-capitalist interests: if the state is functional to the maintenance of capitalism and representative of the interests of the dominant classes it cannot respond positively to the demands of subordinate classes (Crouch op. cit. p. 27-8). Indeed, Poulantzas argues that concessions can be made to dominated classes but these never threaten the political hegemony of the dominant classes and may even be aimed at increasing the political disorganisation of the subordinate classes (Poulantzas 1975A p. 190-3). As Crouch (op. cit. p. 28-9) well argues:

"It is almost as though, having admitted the idea of the relative autonomy of the State, a structuralist theory has to move quickly to close the loophole to elements of pluralism which this might imply by pitching the theory at such an abstract, rigid level that all questions of the respective positions of labour and capital are resolved in the initial formulation and not left open to any modification by actual behaviour."

More generally, the structuralist account implies that the capitalist system necessarily functions in a self-preserving fashion - it is a system of structures which becomes totally unalterable. Social change can therefore only occur by thorough-going revolution. This leads to fatalism and a total neglect of processes by which change can, and does occur:

"Structuralism, therefore, leads to either a passive acceptance of the status quo or an anarchist condemnation of its entirety. Neither position is very helpful in changing it." (Wolfe 1974 p. 140).

An alternative approach to the analysis of the capitalist state within the Marxist tradition is provided by Miliband (1973, 1977). In his initial work Miliband was primarily concerned to provide a critique of 'democratic-pluralist' theory and an empirically-oriented analysis of the class character of the institutions of the State. This drew

considerable criticism from Poulantzas, on the grounds of its a-theoretical and 'bourgeoise' nature, and a long controversy developed resulting in some concessions to the structuralist approach in Miliband's later work. He is essentially concerned to demonstrate, firstly, the existence of an economically dominant class and, secondly, the ways in which it wields decisive economic power (op. cit. 1973 p. 23). He develops his argument for domination of the State by the capitalist classes in terms of three main features. Firstly, control of the central institutions of the state system is in the hands of interrelated elites with common social backgrounds:

"(In) terms of social origin, education and class situation, the men who have manned all command positions in the state system have largely, and in many cases overwhelmingly, been drawn from the world of business and property or from the professional middle classes." (ibid. p. 61).

Secondly, within the state system governments are committed to the maintenance of "...the existing economic and social system of private ownership and private appropriation..." (ibid. p. 64) which limits their policies and actions and produces a bias in favour of capitalist interests (ibid. chap. 4). Moreover, other institutions in the state system (e.g. bureaucracy, military, judiciary) are similarly committed to the "...maintenance and defence of the structure of power and privilege inherent in advanced capitalism." (ibid. p. 115-6; chap. 5). Thirdly, a process of legitimisation of class rule ensures the 'political socialisation' or indoctrination of subordinate classes to accept the existing social order and to confine their demands and aspirations within its limits (ibid. p. 159-61). Miliband adopts Gramsci's concept of 'hegemony' denoting the establishment by the dominant classes of an ideological discourse which provides 'conventional' interpretations of social existence thus legitimising the existing social order (ibid. chaps. 7-8).

In his later work (1977) Miliband made some concessions to Poulantzas in the form of a greater emphasis on the "...structural constraints imposed by the mode of production.." (ibid. p. 74) and on the 'relative autonomy' of the state from sections of the dominant classes which is seen as essential to the performance of its role in relation to the general interests of the dominant classes as a whole (ibid. p. 87). This has overcome some of the criticisms of his earlier work to the effect that it reproduces the 'liberal' tendency to neglect the relationship between the form and content of political institutions and underlying economic forces and that it leans towards the traditional instrumentalist problematic of the state as a tool of the ruling class (Jessop op. cit. p. 357; Dear and Clark 1978 p. 179). But an advantage of Miliband's analysis is its ability to accommodate challenges to the authority of the dominant classes and advances by subordinate classes in terms of their perceptions of their interests.

Jessop (op. cit.) has argued that a more adequate theory of the capitalist state, particularly as regards its role in capital accumulation, can be derived by integrating three stands in neo-Marxist thought in order to overcome the excessive rigidity of deterministic 'structural-functionalism' and to be able to accommodate change initiated by non-capitalist forces. In this way we can arrive, Jessop argues, at a conception of the state as "...a system of political domination, whose forms may be more or less adequate to securing the various requirements of capital accumulation in different situations." (ibid. p. 361).

The first strand is provided by the 'capital logic school' which sees the state as necessarily separated from civil society because an institution which is not immediately subordinate to market forces is

required to provide the general preconditions of capital accumulation which particular competing capitals cannot secure. The state is therefore an 'ideal collective capitalist', a distinct political institution corresponding to the common needs of capital. The state then intervenes in the process of capital accumulation to mobilise counter-tendencies to the falling rate of profit to attempt to avert crises by, for example, the restructuring of capital and the reorganisation of the labour process. (ibid. p. 361-4).

Secondly, attempts have been made to introduce more historical specificity and greater awareness of the role of the class struggle into the study of the capitalist state. It is argued that the state must be understood in terms of its changing functions in the class struggle over the organisation of the labour process and the appropriation of surplus value and not simply in relation to the needs and interests of capital in isolation from its antagonistic relationship with labour. State intervention to mobilise the counter-tendencies to the falling rate of profit must therefore be seen in the context of the changing character of the class struggle over time (i.e. the changing nature of the domination of capital over the labour process), with the form of the state apparatus changing also so as to be suited to the task of reorganising social relations in favour of capital accumulation (ibid. p. 364-6).

Thirdly, the above analyses, which emphasise the structural constraints on the state deriving from the capitalist mode of production, can be supplemented by the 'neo-Gramscian' perspective which places more emphasis on political and ideological domination. Broadly, this approach sees the state not simply as an instrument manipulated by a unitary bourgeoisie class, but rather as playing a vital role in

organising the unity, and political and ideological hegemony, as a fractioned dominant 'power bloc' (while at the same time disorganising the dominated classes) in order to secure the necessary conditions for capital accumulation. The ability of a power bloc of dominant classes to maintain its hegemony is seen as depending upon its commitment to a common ideology, and also on its ability to articulate opposition from dominated classes into that dominant ideology in order to deflect it from revolutionary tendencies (ibid. p. 367-9).

Therefore, the theory of the capitalist state has progressed beyond the 'orthodox' Marxist approaches in terms of the state as a 'thing' or subject external to the capitalist mode of production. Jessop argues that the state must be conceived of as a system of political domination, playing an essential role in securing the historic preconditions for the capitalist social organisation of production; the state and state power must assume a central role in the process of capital accumulation. It is not a case of the way in which the dominant capitalist classes actively and internally use state power to defend and promote the capitalist system but rather a question of seeing state power as an institutional manifestation of the class struggle (i.e. as a particular field of conflict between different class interests), and as an essential element in the reproduction of capitalist social relations. The state institutions and apparatuses are, therefore, not neutral acting in the interests of 'society as a whole', but integrated into the movement of capital, and they will change as capitalism changes and develops. Hence, the success of state intervention in securing the conditions for capital accumulation, managing crises and solving perceived problems will depend upon the balance of political forces in various class and popular democratic struggles and failure of policy measures can be analysed in terms of

the balance of such forces, the adequacy of forms of political representation and the structure of the state apparatuses and the nature of the perception and analysis of the problem (ibid. p. 369-71).

Such an approach, then, provides useful elements for a conception of the rationale for the development of social scientific knowledge in our society. The central point which can be extracted from the 'Marxist' account is the essential dual role performed by the state involving, firstly, the promotion of the conditions for capital accumulation and, secondly, the legitimation of its activities in this respect. More generally, this can be seen within the context of a broader role of maintaining the stability of the capitalist system on the basis of a contradictory process of expropriation of power from the people on the one hand and its re-imposition upon them, in the form of an 'objective' consciousness on the other (cf. Crouch op. cit.; Wolfe op. cit).

The primary means to the maintenance of social stability in liberal democratic capitalist societies is through economic prosperity; the major preoccupation of the state, therefore, is with securing the interests of the existing mode of production viz. managing the economy in the interests of capital accumulation (Crouch op. cit. p. 40). But also important are means to ensure the maintenance of existing structures of political power involving, for example, legal frameworks and their imposition by the institutions of 'law and order'. Finally, a dominant ideological discourse, and the means to propogate it, are essential to the legitimation of the state as a 'universal' institution pursuing the 'common interest' of society as a whole and to the manipulation of consciousness so as to achieve a broad consent in the basic structure of capitalist society (cf. Wolfe op. cit. p. 156-9).



At this point, then, we can relate the discussion back to the framework provided by the consideration of the work of Berger and Luckman and Habermas (cf. above p.202-8) and summarise some common elements in a conception of the broad 'problematic' in relation to which social knowledge is developed in our society. Firstly, there is an emphasis on the maintenance and transmission of social order and stability and of the means to achieve social control. Such control and stability is maintained through the development of an institutional structure which arises out of and embodies (and in turn reinforces) the pattern of segmentation and structuring of relationships between different groups in society. Within this institutional structure, the institutions of the state have achieved a predominant position and require legitimation in order to claim the authority required to achieve order and stability. Legitimation is achieved through a system of social knowledge and language within which broad 'world views' provide people with interpretations of the 'meaning' of institutions and society; more specifically, bodies of knowledge are produced which are 'taken-for-granted' and can command authority (for example, as 'the truth') in presenting institutions as 'natural' (even as 'supra-human' entities) and as existing to serve the interests of all people in society.

However, we can take the conception further with reference to the work of Claus Offe (1975, 1976). Offe attempts to move beyond the traditional Marxist formulations of political authority based on structurally privileged interests of the dominant classes while still accommodating the 'authoritarian' nature of the organisation of political power in an advanced capitalist society. He argues, specifically, that the role of the state in such a society can be understood with reference to an 'objective imperative' for the management of three fundamental system problems which is vital to the survival of the capitalist system

as a whole and to the maintenance of its stability (op. cit. 1976 p. 412-3).

The first set of problems have to do with economic stability and include, for example, the maintenance of balanced economic growth and full employment, the provision of investment incentives etc; these basically refer to the political mediation of capital accumulation which has a key role in maintaining the stability of the system (ibid. p. 413). Since capitalism is neither self-regulating nor self-sufficient the state must create and sustain the conditions for capital accumulation and its decision-making power depends, in turn, upon the continuity of the accumulation process and, for example, the taxation revenues based upon it (op. cit. 1975 p. 126).

A second class of problems relates to foreign policy, trade and military policy which are again important to social stability (op. cit. 1976 p. 413). And, thirdly, there are problems concerned with ensuring 'mass loyalty' or 'legitimation' involving the control of conflict between interest groups and the maintenance of "... apathetic conformity to the agencies of the political system..." (ibid. p. 414). This requires an ideology to identify the measures required for capital accumulation with the pursuit of the 'national interest'; Offe argues that:-

"... only if (and only as long as) the capitalist state manages, through a variety of institutional mechanisms, to convey the image of an organisation of power that pursues the common and general interests of society as a whole, allows equal access to power and is responsive to justified demands, (can) the state... function in its specific relationship to accumulation." (op. cit. 1975 p. 127)

Offe therefore derives a 'model of rational administration' involving

"...cautious crisis management and long-term avoidance strategy..." (op. cit. 1976 p. 415); priority will be accorded to problem areas in proportion to their perceived importance to stability and to social needs in proportion to their potential contribution to the maintenance of a risk-free situation (ibid. p. 416). As the capitalist state is increasingly forced to become itself involved directly in the production system as well as to provide the general social conditions for accumulation, so the process of policy formulation becomes increasingly concerned with responding to perceived problems. In such a context, Offe argues, decisions cannot be made solely on the basis of overt class or group interests in the political system; rather, new formal procedures are required to balance the functions of the state with its internal structure (op. cit. 1975 p. 128-34). The main result has been the growth of the process and techniques of 'rational planning' as a 'formal' construct. However, underlying contradictions remain between the functions of the state and its internal structure due to conflicts of interests between different classes and groups which produce conflicts over the goals and side-effects of the state's productive activities (ibid. p. 134-44). As Habermas (1976B p. 375) argues, the state then faces a 'crisis of rationality' to the extent that its policy outputs fail to solve the problems of control taken over from the economic system.

Offe and Habermas develop further the theme of the essentially contradictory nature of the role of the state and the implications of this for the model of 'rational administration'. In addition to the 'crisis of rationality' arising from the state's extension of its productive activities and formal planning procedures, such an extension also exacerbates the problem of legitimation. Thus, as the state extends its activities and areas of life previously assigned

to the private, 'market' sphere are 'politicised' and subject to practical discussion and planning, so the burden of legitimation increases (Habermas 1976B p. 375-8). This produces strains upon the dominant legitimising frameworks of knowledge due to the growing discrepancy between the need for motives and meanings announced by such frameworks on the one hand, and the motivation actually offered by the capitalist social and economic system on the other (cf. *ibid* p. 379-83).

The problem of legitimation is further aggravated, Offe argues, by the disparities which arise from the 'priorities of rational administration' for the capitalist state. Concern by the state for the priority problems of stability through capital accumulation, management of effective demand, maintenance of foreign trade relations, avoidance of military crisis and prevention of domestic conflict, will result in certain other social needs (e.g. social welfare and support) being afforded peripheral importance (Offe 1976 p. 416-7). However, such disparities require further legitimation and aggravate the difficulties for legitimising frameworks of knowledge which present the state as an institution which embodies the 'general interest' of the population. As Habermas (1976B p. 379) argues:

"Even if the state apparatus were to succeed in increasing the productivity of labour and in dividing the profits of productivity in such a way that economic growth free from crisis if not from disturbance were assured, this growth would come about in accordance with priorities whose development is not dependent on the generalizable interest of the population. The pattern of priorities which Galbraith has analysed under the heading of 'private wealth v public property' results from a class structure however much that class structure may be rendered latent."

Moreover, problems of maintaining the legitimacy and authority of the state can be seen as reacting back on the 'crisis of rationality'. For example, in order to ensure continued loyalty and support the

state cannot permit 'public poverty' to become sufficiently problematical as to promote opposition and protest which might pose a threat to the stability of the system. Consequently, public expenditure must be allocated to such needs (for example, in the form of welfare payments and public housing) and such expenditure is boosted by such political pressure as can be brought to bear by representatives of the classes and groups concerned. However, the need for such expenditure then exacerbates the 'fiscal problem' which arises with growing state participation in rationalising the productive activities of the capitalist economic system.

Within such a conception, then, social knowledge can be seen as having to bear a dual burden. On the one hand it must provide a basis for the rationalising activities of the state in relation to the problem of the maintenance of stability and order through analyses of economic, political and social processes upon which action can be based. On the other hand, it must contribute to the legitimation of the existing institutional order by providing a 'form of consciousness' through which the system is perceived as a natural, historical necessity, providing for all social needs according to just and proper principles of individual achievement and responding to all interests freely and equally expressed. These elements interact in a complex way and, indeed, are unlikely to be separable into discrete components; for example, the 'solution' of a particular social problem will, as argued earlier, involve both 'rational' and 'legitimatory' (or, in Berger and Luckman's terms 'cognitive' and 'normative') components which operate through the states of perception, analysis, decision and action to produce material changes in the particular system of interest and to legitimise the problematical situation. The presentation of social knowledge as objective and independent of

of normative foundation disguises its legitimacy component and therefore provides the authority which such knowledge requires for the achievement of legitimation under the banner of 'rational scientific analysis'.

#### 5.4 Conclusion

It is now appropriate to summarise the discussion as it has developed in this chapter. The central concern has been with developing our conception of social knowledge as a necessarily value-contingent phenomenon, in terms of the nature of its relationship with characteristics of the social, cultural and political context with a view to better understanding the way in which social knowledge develops upon a particular normative foundation. The discussion has focussed upon a view of the development of social knowledge in relation to the need to confront and solve problems which continuously arise concerning social relationships. Such problems are perceived and tackled within a particular institutional and social framework which constitutes a 'constrained world' and different world-views arise from different locations within this framework. Such locations are defined in terms of social values and interests which provide the essential normative bases for cognitive structures. That which is accepted as viable and relevant knowledge can be seen as contingent upon the normative basis upon which 'relevant' and 'significant' problems are defined and attempted solutions derived.

Consequently, it can be argued that particular interpretations of the meaning of the social world and its problems condition the process of development of knowledge about that world. Such interpretations, constituting 'universes of reality and value' are reinforced by the

problem-solving process which involves a complex interaction of

'rational-cognitive' and 'normative-legitimatory' components.

'Conventional' or 'orthodox' interpretations of social meaning become taken-for-granted definitions of social and institutional reality which serve to legitimise the institutional order and therefore contribute to the solution of the broad problem of the maintenance and transmission of social order, stability and control. Such dominant schools of thought about the social world, although underlain by particular evaluative frameworks and embodying particular normative presuppositions, must be presented as 'above' all such partisan normative influences in order to retain their power as conceptual machineries legitimising the existing institutional order.

In advanced industrial societies the institutions of the state have become particularly important within the wider institutional structure and it can be argued that the process of social knowledge development has become closely tied to the functions and requirements of the state. In broad terms, the state in advanced capitalist societies can be seen as primarily concerned to maintain social order and stability through promoting the conditions for continued long-term capital accumulation, through maintaining the stability of foreign relations, through maintaining institutions of social control, and through securing the conditions for the hegemony of a particular 'universe of meanings' or framework of social knowledge which legitimises the institutional order and therefore serves to secure mass loyalty to the system. As concern with these problems has led the state to expand its sphere of activity in the capitalist democracies there has been an increasing requirement for the development of 'formal procedures' of planning and allocation overlaying the realm of power political conflict. This can be seen as having increased the burden on the state in respect of its problem of

maintaining the legitimacy of the institutional order and also as having placed greater demands upon the processes of social knowledge production for knowledge which is widely accepted as constituting a firm, 'rational' foundation for action by the state in the 'formal realm'.

Therefore, as the role of the state in advanced capitalist society has expanded so the development of social knowledge can be seen as having become increasingly tied to Offe's broad problematic of 'cautious crisis management and long-term avoidance strategy'. In many subject areas 'applied studies' have increasingly dominated the development of the field as a whole; this is shown particularly strongly in neo-classical economics in which attention has focussed progressively more on econometric modelling in a macro-economic context as a basis for economic planning. The field of planning studies as such has burgeoned, becoming increasingly the focus for applied studies in the fields of, for example, economics, politics, sociology and geography.

These developments, then, have substantially increased the burden on social scientific knowledge in terms of the requirement for both 'rationality' and 'legitimation'. Against this background it is possible to develop an interpretation of the ideological implications of recent trends in the nature of such knowledge and in views relating to its usage in the political-administrative process. Two trends are perhaps of particular significance. Firstly, as argued in earlier chapters, the last two decades have been characterised by the growth of quantitative modelling and techniques of analysis in the social sciences, within the positivist epistemological tradition, and in emulation of the 'respectability' of the natural empirical sciences; such techniques are conventionally interpreted as increasing the 'scientific quality' of social science and consequently its reliability as a basis for



action. Secondly, concomitant with these trends, there has been an increase in faith in the results of science as a guide to political action and in the opinions of 'scientific experts' relative to those of 'ordinary citizens'. More generally, with the growing intervention of the state and the development of rational administration politics has become increasingly governed by "... technically interpreted avoidance imperatives..." at the expense of "...guidelines for action based on a consensus." (Offe 1976 p. 419). Rules guiding administrative actions are, therefore, non-practical, 'technical preventive' rules which are seen as derivable from science. But the legitimacy of such a model of politics depends upon the assumption that political outcomes from such a process are in the interests of society as a whole and somehow 'better' than those which would arise from the traditional exercise of political power. As Offe (ibid p. 419-20) argues:

"Unconditional technocratic rationality can only flourish in the shadow of ideological postulates.....it is the task of the ideology planners' to produce this rationality."

The result can be seen as a 'technocratic ideology' which legitimises modern politics in terms of a rationality based upon the guidance of objective knowledge dispensed by impartial experts. This is now an important component in the dominant framework of ideological knowledge in our society, a development from theoretical frameworks which have traditionally provided the basis for social guidance and legitimation. Since its themes can be expected to exert an important influence upon the consideration of public policy issues the next chapter will be concerned to elaborate a conception of this 'dominant ideology' as it relates to the state and the problem of public policy formulation.

## Chapter 6: Normative Themes of a Dominant Technocratic Ideology

### 6.1 Introduction

In the previous chapter I argued that the development of social knowledge has become closely tied to the requirements of the state to achieve and maintain social order and stability and has been particularly influenced by the greater involvement of the state in the economic sphere and in social life in general. The policy activities of the state, and the institutional forms through which they are manifested, are influenced by the balance of social forces in the complex structures of social relationships and with the emergence of modern procedures of 'rational administration' and planning, interpretations which rely solely on the class dimension of political power would appear to have been rendered rather too simplistic. Through such institutionalized procedures the realm of political power, based on conflicts between various class and interest groups, can be seen as overlain by a 'technical' process based on a rationality derived primarily from the realm of knowledge. The nature of policy outputs can therefore be seen as increasingly mediated through this 'technical domain' and an understanding of the nature of the 'rationality' of social knowledge and its use in this domain has consequently become of considerable importance. I have argued that the process of production of social knowledge in our society is such that a dominant framework of ideological knowledge arises which serves both to inform the problem-solving activities of the state and to legitimise those activities and the wider institutional structure. As the nature of the state has evolved so too has the nature of the 'dominant ideology', now referring more to the 'technical domain' of the state's activities while power political aspects have tended to become more submerged.

This ideology is, therefore, increasingly 'technocratic' - increasingly concerned with the application of knowledge to social guidance in technical administration.

The concept of ideological hegemony has been defined as ...

".. an order in which a certain way of life and thought is dominant, in which one concept of reality is diffused throughout society in all its institutional and private manifestations, informing with its spirit all taste, morality, customs, religious and political principles, and all social relations, particularly in their intellectual and moral connotations."

(quoted in Miliband 1973 p. 162).

Within such a comprehensive order it is possible to define the main ideological features relating to the problematic of the state and public policy formulation; it is this more limited definition to which I shall refer when using the term 'dominant ideology'. Such a sub-ideology' (or 'practical ideology') can be conceived in terms of three primary conceptual components or attributes: firstly, a conception of the process of production or development of knowledge; secondly, a conception of the substantive nature or content of the social world; and, thirdly, a conception of knowledge utilization i.e. the way in which knowledge is to be applied in informing human practical action. These components should be seen as interrelated and mutually reinforcing in relation to the role of informing and legitimising the activities of the state; for example, the nature of the theoretical content depends upon the process of development, and the conception of utilization necessarily embodies a model of development and, in turn, plays a part in justifying such a model. This chapter will therefore be concerned to examine the nature of these components as they are manifested in the dominant ideology of our society in relation to the consideration of public policy issues with a view, in particular, to identifying the underlying normative commitments of this framework of knowledge.

## 6.2 A Conception of Knowledge Development

This fundamental component, which determines the broad outline character of the dominant ideology, is provided by the positivist epistemology which underpins the development of orthodox social science. The major elements of this epistemological position were critically analysed in chapters 2-3; here the focus is on their ideological implications. The main tenets of the positivist account are, once again, firstly, that scientific knowledge must be based upon facts-as experienced, secondly, that value judgements and normative statements cannot be scientific because there is no empirical basis for testing their validity, and, thirdly, that social science must proceed by way of the methods of the empirical natural sciences in order to achieve 'objective knowledge'.

The positivist conception, then, is founded upon an acceptance of empirical facts as they present themselves to experience and is concerned with the construction of abstract, formal laws on the basis of such 'given' facts. But this apparently scientific method can be seen as neglecting the historical, social and dynamic character of those facts and, in the quest for universal, abstract laws, as 'fixing' the phenomena of capitalist society as 'suprahistorical essences' (cf. Lukacs 1971 p. 5-14). Consequently, the notion that capitalist society is an historical and transitory phenomenon subject to continual change is 'written out' of social theory.

"The crudeness and conceptual nullity of such thought lies primarily in the fact that it obscures the historical, transitory nature of capitalist society. Its determinants take on the appearance of timeless, eternal categories valid for all social formations." (ibid. p. 9)

This theme is also taken up by Bhaskar (1975) who argues that the assertion by positivism that experience constitutes the basis for all valid knowledge rules out the possibility of questioning the conditions under which experience is significant in science:

"The concept of the empirical world is anthropocentric. The world is what men (sic!) can experience. But the couple of this concept, and from a realist meta-perspective necessary to sustain it, is the absence of the concept of antecedent social activity necessary to make experience significant in science. And this has the objectionable ideological consequence (from the point of view of the practice of science) that whatever men currently experience is unquestionably the world." (ibid. p. 58)

"It is clear that if knowledge is regarded as justified in terms of given experience we have the makings of what is in effect a conservative ideology, in which the current experiences of a science are rationalised in being thought of things themselves." (ibid. p. 243).

Of course, the notion that experiential data can provide a firm foundation for scientific knowledge of the social world is based upon the assumption that such data can be observed independently of theoretical and subjective presuppositions. As indicated in chapter 2, acceptance of the arguments on this issue of Popper, Kuhn and philosophers of the 'conventionalist school' renders such an assumption untenable. Indeed, the Popperian position now relies on the distinction between the 'psychology' and the 'logic' of knowledge the latter, in the form of falsificationism, applying equally to natural and social sciences and guaranteeing objective social knowledge. But I have argued that this position, too, is untenable and it can be suggested that its acceptance serves to promote the ideological purpose of concealing the value-commitments which must be manifested in social knowledge being a legitimizing facade of 'objectivity'.

Consequently, such an epistemology, in denying the necessarily value-contingent nature of the social knowledge which it produces, serves a fundamental legitimatory role, shielding the components of the dominant ideology from criticism on the basis of their scientific validity. As Habermas has argued ...

"...by making a dogma of the sciences' belief in themselves, positivism assumes the prohibitive function of protecting scientific inquiry from epistemological self-reflection. Positivism is philosophical only in so far as is necessary for the immunization of the sciences against philosophy." (quoted in McCarthy 1978 p. 40).

At the highest level positivism legitimizes itself as an epistemology with reference to the development of objective knowledge about the world to counter-act the influence of dogma. I have already referred to Habermas' argument to the effect that positivism therefore embodies a value - commitment which renders it, in itself, ideological (cf above ch 2 ; Habermas 1976A).

Moreover, the positivist emphasis on quantification and mathematical organisation of formal systems of laws has important implications. For example, with reference to neoclassical economic theory Dobb (1973) criticises the notion that formal economic analysis using quantitative techniques and mathematical language is objective and independent of statements with substantive content; on the contrary, he argues that the structure of mathematical models in economics is highly relevant to the nature of the statements they make about the economic world:

"In choosing one structure in preference to another, the model-builder is not only providing a scaffolding or framework within which human thought can operate, but is laying emphasis on certain factors and relationships

and excluding others or casting them into the shadows- and in doing so he (sic!) can be judged to be distorting or illuminating reality, and thus affording an unsound or sound basis for interpretation and prediction - more likely perhaps he is illuminating some corners or facet of reality, or certain situations that recur, at the same time as he is obscuring, or totally concealing, others." (ibid. p. 7).

Further, such trends towards quantification, in particular towards the apparent descriptive neutrality of systems of simultaneous equations, have concealed ideological implications deriving from various sources (ibid. p. 8-10). Firstly, the treatment of certain variables in such a system as exogenously determined, or as constants specified as data, can result in an order of determination being imposed on the system in an implicit manner. Secondly, the introduction of additional hypotheses that were no part of the scheme in its 'pure' form, for example, by imputing particular values to certain variables, yields interpretations which give a theory its essential character and practical implications. And, thirdly, the definition of the boundaries of the theoretical system (i.e. the sphere of 'relevant' interactions) is crucial to the identification of determining influences. All these are sources of 'bias' in the analysis of the economic system which are regarded as unproblematical within the positivist tradition but which should be seen as meaningful, deriving from paradigm-dependent judgements by the analyst and imparting socially - and historically-conditioned value commitments to the analysis of the economic world.

The emphasis on the attainment of social knowledge via the development of abstract formal system and mathematical models produces further potential problems. In particular, an important source of models in the process of theory development is provided by analogies with processes already conceptualised in more established, perhaps

more 'respectable', areas of inquiry. The nature of such substantive analogies can therefore be of considerable significance. In general terms the positivist framework lacks a high-level conception of science as a process-in-motion, and of the process of production of knowledge as rooted in a particular material social context (rather than an isolated mental process). As a result, science and philosophy tend to become tied together in a self-perpetuating ideology. Philosophy is derived with reference to the current state of science and is, in turn, called upon to rationalize and justify the continuing activity of science. Moreover, since philosophers of science have tended to concentrate upon particular scientific disciplines for the raw material of their reflections then to the extent that these reflections subsequently influence the practice of science in other disciplines, these can result something of a 'convergence' effect, with our understanding of a complex world developing in terms of a particular image.

For example, physics has traditionally been the discipline which has attracted most the reflective attention of philosophers of science and which, moreover, has actually produced such philosophers. Levy-Leblond (1976) refers to the 'ideological exploitation' of modern physics in terms of the uses of the results of quantum physics, particularly, for example, the invocation of the 'free will' of the electron to establish the free will of human beings (ibid. p. 158-9). He quotes from Max Born's autobiography as follows:

"Eastern (sic!) Marxism teaches that communist economy is a historical necessity, and from this conviction stems its fanaticism ..... Physics has now developed the statistical interpretation of the laws of nature which correspond better to reality; from this new viewpoint, the belief of the communists in the inevitable realisation of marxist predictions seems grotesque." (ibid. p. 159).



Clearly, this is an extreme example, the absurdity of which really requires no elaboration; however, most analogical influences are rather more subtle. Historically, perhaps the most important of all sources of substantive analogies in the development of western science has been Newtonian Mechanics. Bhaskar (op. cit. p. 61) suggests that ...

"... the influence of Newtonian Mechanics on 18th century philosophy led to a kind of stasis in thought from which the philosophy of science has still to recover. Action-by-contact as a paradigm of causality, the celestial closure as a model of knowledge, gravity as a template of our ignorance all had a disastrous effect."

Amongst these effects the idea that the 'celestial closure' embodied both a model of phenomena and a model for science created a misconception of considerable consequence. The founding of science upon the notions of constant conjunctures of events and the deterministic nature of the universe derives from the tacit assumption of the universality of closed systems (ibid. p. 67-9). Now, system closure requires three primary conditions: firstly, isolation from external influences or constancy of those influences; secondly, isolation of individuals within the system from the influence of other individuals or constancy of those influences i.e. atomicity; and, thirdly, the assumption that overall system states represent the sum of the states of the (atomistic) individual components i.e. additivity (ibid. p. 73-7).

However, the conditions of atomicity and additivity imply a particular 'paradigm of action'. Based upon a conception of matter as passive, inert, rigid 'corpuscles' moving under external stimuli according to strict laws of mechanics, and of causation as linear and unidirectional, with no qualitative variety and transformation,

the positivistic epistemology of this paradigm of action views things as ultimately resolvable into simple quantities apprehended in sense-experience, and causation as the regular concomitance of atomistic events. The concept of action presented by this world-view therefore involves the simple response of passive atomistic individuals to external stimuli in a linear process, with such events directly amenable to observation. Events are conceived as 'displacements' rather than 'transformations' - there is no conception of the transformation of complex, pre-formed situations with material continuity preserved through the change. If all efficient causes are extrinsic then the structure or organisation of an environment cannot be a determinant of what happens within it (ibid. p. 79-90).

Embodied within this classical paradigm of action, then, is a model of humans as sensors of given facts and recorders of their regularities. That is, humans are seen as passive spectators of a given world rather than active agents in a complex and dynamic one. As Lukacs (op. cit.) argues, in the positivist ideal of formal systems of mathematical relationships the attempt to eliminate all subjective elements and ..."every anthropomorphic tendency....." transforms the subject, the knower, into a purely passive 'contemplative' role. Knowledge becomes transformed....." more and more into the systematic and conscious contemplation of .... purely formal... 'laws' which function in - objective - reality without the intervention of the subject ..." (ibid. p. 128). Human relations become mere objective elements in such abstract formal systems, therefore defined as immutable. (ibid. p. 127-31).

The content of this world-view has had considerable substantive influence upon the development of scientific knowledge within the positivist tradition. The impact can be seen especially in the social

sciences and it is possible to illustrate the implications with reference, once again, to neoclassical economics. The arguments of Georgescu-Roegen (1971, 1976) are of particular relevance here. He argues, basically, that the development of neoclassical economic thought on the basis of the analogy of classical mechanics, and the resulting dominance of the conception of the economic process as a mechanical analogue, renders such thought incapable of accounting for the existence of enduring qualitative change which characterises economic phenomena. More specifically, neoclassical models treat phenomena undergoing continuous change as if they were not changing with time:

"In this representation, the economic process neither induces any qualitative change nor is affected by the qualitative change of the environment into which it is anchored. It is an isolated, self-contained and a historical process - a circular flow between production and consumption with no outlets and no inlets." (op. cit. 1971 p. 3).

Consequently, the economic process is reduced, by physical analogues, to the 'Jevonian problematic' of the...."mechanics of utility and self-interest"...(op. cit. 1976 p. 53; cf. above chapter 3) essentially merely a ..."jigsaw puzzle with all its elements given." (op.cit. 1971 p. 319). The fundamental laws of economics are seen as deducible from universal principles of individual behaviour and therefore as universal themselves. And this has produced a conception of society based on the hypostatisation of the institutional traits of western industrial capitalist societies. In this conception individuals are seen as maximising their 'utility' or satisfaction only in terms of commodities - goods and services obtained through market exchange perceived in abstraction from an economic process involving irrevocable, qualitative material change which occurs subject to the dominant values of a specific institutional and cultural context (op. cit. 1971, 1976).

Positivist epistemology therefore constitutes a fundamental underlying component of the dominant ideology providing a basis both for the development of ideological social knowledge and for legitimization of such knowledge. In particular, the positivist tradition produces knowledge primarily in the guise of formal systems of quantitative relationships while at the same time justifying such a form of knowledge as objective, value-free and of superior cognitive validity. The substantive theoretical content of the dominant ideology must therefore be analysed in this context.

### 6.3 The Theoretical Content of the Dominant Ideology

In relation to the problem of public policy making in advanced capitalist industrial societies certain bodies of theoretical knowledge can be seen as of particular importance to the structure of the dominant ideology. Anderson (1976 p. 195) argues as follows:

"In the Anglo-American world particularly, we continue to define public problems and to deliberate policy alternatives largely in terms of the conceptual apparatus of the common law, democratic theory, and a market-based political economy, and this despite the almost total transformation of these societies in the last two hundred years. Certainly, the content and character of these systems of thought has changed with time, but the basic logic and the essential standpoint for appraising public issues has been retained."

Within this conceptual apparatus of the dominant ideology, the framework of law obviously has important influences on the consideration of public policy issues; however, this complex area requires detailed study in its own right and is beyond the means of the present analysis. Rather, I shall concentrate on the nature of theoretical knowledge in the fields of democratic political theory and neo-classical economic theory.

The development of both these theoretical frameworks can be related historically to the broader tradition constituted by 'classical liberalism' which matured in the late eighteenth century in 'utilitarianism' (Macpherson 1972; Ward 1972). The emergence of neo-classical economic theory was examined above (in ch. 5 ) but it is appropriate here to relate this tradition to the classical philosophical world-view which, I have argued, developed under the influence of the 'mechanical analogue'. Classical liberalism, then, was essentially characterised by three major assumptions (or doctrines) about what was inherent in 'human nature' (Ward op. cit. p. 24-5;

Hunt 1972 p. 44-7). Firstly, Hobbes' egoism, which held that all motives were a disguised species of self-interest, was combined, by Bentham, with an 'hedonism' which reduced human behaviour to the satisfaction of urgent demands of mind and body. This selfish view of human motivation was also supported by Locke and Smith. Secondly, 'rationalism' characterised hedonistic behaviour in terms of conscious choice amongst alternative means to maximise achievement of ends. Thirdly, an 'atomism' emphasized the essential separateness and autonomy of each individual; individuals were the fundamental unit in society, social institutions being merely a product of such individuals whose freedoms were regarded as paramount.

This scheme can therefore be seen as introducing a social and behavioural dimension to the classical 'paradigm of action' which provided a basic framework for the development of social theories. From this tradition emerges the picture of free, autonomous individuals behaving rationally and maximising their 'utility' in market exchange and of a political system which exists to maximise the welfare of society as a whole by protecting the individual's freedoms and the resources privately accumulated through the exercise of those freedoms in the market place. As regards the economic component of this picture, then, Ward (op. cit. p. 25-6) argues that:

"The model of liberal man (sic!) is exemplified in the theory of consumption which appears in all the economic textbooks and informs a great deal of the research... . The autonomous individuals of economics come into conflict, but this conflict is dramatically transformed by the bargaining processes of the market place into a harmony of interests, a Pareto-optimality in principle whose liberal credentials are impeccable."

Consequently, the basic assumptions upon which neoclassical economic models are founded can be seen to derive from, and in turn reinforce, an essentially normative tradition which promotes a view of society as a homogeneous, uniform collection of autonomous individuals tending towards a state of social harmony through a process of equal exchange in the market place. For example, assumptions of rational action to maximise given ends, of consistent arrangements of individual preferences, of homogeneity of economic agents, of equilibrium tendencies in market exchange processes, of perfect substitutability and flexibility in production, of uniformity in processes over time - such assumptions are basic to neoclassical models. Underlying them are two essential theses which characterise the normative orientation of neoclassical economics: firstly, that all market payments are simple exchanges in an equal sense so that in equilibrium all agents benefit and maximise their satisfaction or utility; and, secondly, that all market costs are costs paid for productive work in an equal sense, and that in equilibrium remuneration for an agent is proportional to marginal productivity (Hollis and Nell 1975 ch. 8).

The claim of objectivity and value freedom in the application of neoclassical economic theories and models to the analysis of economic phenomena produces ideological consequences deriving from the above theses and the more specific assumptions to which they give rise. A picture is presented of household and firms as equivalent free agents involved in the essential process of exchange of productive services and final products controlled by the mechanism of 'rational choice'. Households supply the services of productive factors (mainly labour) and demand final goods and services in quantities and proportions that best satisfy their 'relative preference schedules' (or maximise their utility). Firms demand labour and other 'factor

services' according to their technical opportunities and needs in relation to consumers' demand for products, and supply final goods and services, in relation to prices which consumers are prepared to pay, so as to maximise their profits. The equilibrium supplies and demands finally chosen will be simultaneously compatible solutions to these different individual, rational, maximisation problems. In the equilibrium solution, which is achieved automatically by the 'invisible hand' of the market clearing process, consumers achieve maximum possible satisfaction, with the value of household factor supplies just matching aggregate household demand, and the output of goods and services by firms matching consumers' demand and also equalling the value of productive services which business demands. Competition ensures that all markets are cleared and that excess profits are eliminated (ibid. p. 14-15, 206; Nell 1972 p. 76-7, 86-8).

Now this outline is admittedly a rather crude and simplified version of the neoclassical theory and modifications are made to it in order to take account of 'imperfections' in competition. However, such modifications do not alter the basic model and the above outline does represent the underlying scheme. The focus is on the process of exchange but economic agents and the exchange relations into which they enter are abstracted from their social, political and historical context provided by the institutional structure of an advanced capitalist society. The mode of abstraction adopted in developing the theory derives from the positivist epistemology which emphasises the creation of logical and precise abstract systems rather than the identification of 'causative' elements in the actual situation. Consequently, exchange phenomena are abstracted from a wider set of economic and social relationships, in an attempt to derive abstract,



logically complex and quantifiable generalisations which will hold for any type of exchange economy (Dobb 1972 p. 42).

Of course, all models or representations of the economic system must be based upon generalised, value-contingent abstraction from a 'perceived reality' and therefore none can be upheld as embodying the 'essence' or 'truth' of an economic reality. The dominance of neoclassical economics as a supposedly value-free science can be related to the normative basis of its particular form of abstraction. In general terms, in abstracting from the social and institutional context of a capitalist economic system neoclassical theory neglects questions relating to the social relations of production and to important processes behind the distribution of income and wealth. By essentially ruling such questions outside the realm of 'scientific' investigation neoclassical theory serves to legitimise the 'status quo' in relation to such issues and therefore can be identified with the interests of those social classes and groups with wealth and privilege within the existing economic order.

More specifically, the emphasis within the theory on purely market relationships and on the primacy of the 'subjective theory of value' results in a neglect of the process of production, technological interdependencies and the role of various institutions (e.g. financial institutions). Neoclassical analysis therefore tends to play down the influence of supply-side factors on prices, the role of profits in determining the choice of industrial techniques and the dependency of such profits upon aggregate demand<sup>and</sup> the state of the labour market. Moreover, profits are represented as exchange payments in the same sense as wages; that is, the ownership of capital and labour are presented as equivalents (Nell op. cit. p. 81-8; Hollis and Nell op. cit.

p. 15-16). Income distribution between 'factors of production' is therefore shown to be an outcome from the market exchange process arising from the prices of productive services or factors which are derived from the market for final products - that is, according to the structure and intensity of consumers' demand.

Consequently, marginal productivity theory, in the neoclassical scheme, provides a particular perspective on the question of the distribution of income and wealth. That it is a selective and partial perspective is indicated by the existence of alternative partial perspectives which emphasize different economic processes. For example, it is possible to argue that consumers' demand is to a considerable degree determined by the prior distribution of income between individuals; income distribution is determined prior to, and as a precondition for, the determination of price relations or exchange values. Similarly, it can be maintained that the provision of labour in return for wages is not equivalent to the ownership of capital leading to accumulation of profit (cf. Nell op. cit. p. 78-88; Dobb 1973 p. 34). Nell (ibid. p. 77-8) criticizes the neoclassical scheme from the latter position:

"Basically, orthodox theory is a theory of markets and market interdependence. It is a theory of general equilibrium in exchange, extended almost as an afterthought to cover production and distribution. It is not a theory of a social system, still less of economic power and social class. Households and firms are considered only as market agents, never as parts of a social structure. Their 'initial endowments', wealth, skills and property, are taken as given. Moreover, the object of the theory is to demonstrate the tendency towards equilibrium; class and sectoral conflict is therefore ruled out almost by assumption."

In presenting a partial analysis from a particular viewpoint as an objective scientific analysis neoclassical economics 'fixes' certain

biases in the way that economic processes are conceptualised and, further, renders the study of factors excluded from its scheme 'non-scientific' from an economic point of view i.e. to be accepted as given to economic analysis. However, to criticise it simply as a distortion is to miss the point that any conception of the economic system must involve 'distortion' due to the necessarily value - conditioned nature of the process of social knowledge development. The essential problem lies in the representation of this particular conception as embodying true knowledge of capitalist economic reality and therefore in the promotion of a particular normative, value stance in the name of 'value freedom'. The same argument can be applied to any attempt to portray an analysis of the economic system as capable of uncovering objective truths. However, in our present society the neoclassical scheme is dominant and can be seen as legitimising certain social interests and promoting a broad normative tradition deriving essentially from the classical liberalist view of society combined with a materialist orientation inherent in the focus on the process of market exchange of commodities and in the identification of social welfare with quantities of such exchange commodities.

As indicated above modern political theory shares common origins with neoclassical economic theory and the historical development of the two fields can be seen to follow similar paths. As we have seen, the development of classical liberal theory in the seventeenth and eighteenth centuries, through the work of Hobbes, Locke, Hume, Burke and Bentham, was closely related to the fundamental economic and social changes which were resulting from the emergence of the capitalist industrial system and the establishment of market relations. The 'hedonistic', 'atomistic' and 'rationalistic' nature of classical

liberal thought was analysed above (cf. p.243 ) as providing an underlying normative framework for the development of economic theory. With reference to political thought, C.B. Macpherson (1962, 1973) has suggested the concept of 'possessive individualism' to characterise the underlying assumptions of classical liberal theory.

Briefly, 'possessive individualism' presents a view of humans as essentially characterised by individual freedom from dependence on relations with others except those voluntarily entered into with a view to promoting self-interest. Such self-interest is served by maximising satisfaction in terms of possession; therefore, freedom is identified with possession or ownership and everyone is free because they possess at least their own capacities. Society is seen not as a system of relations of domination and subordination between individuals and groups held together by reciprocal rights and duties, but rather as a collection of free and equal individuals related to each other through possessions - through ownership of capacities and what they have produced and accumulated through their use. In other words, human society is seen as consisting fundamentally in a series of market relations for the exchange of individuals' possessions. Finally, political society is conceived as a rational human contrivance for the protection of the individual's personal capacities and freedoms and of the property accumulated through the exercise of those freedoms (Macpherson 1962 p. 263-4; 1973 p. 199).

However, during the nineteenth century there was a reaction against the bare materialist and market morality embodied in this classical view of infinite appropriateness as the essence of rational human behaviour. For example, John Stuart Mill rejected the narrow materialist conception of the human essence embodied in 'possessive individualism'

and emphasised instead a broader conception of this essence embodying moral, intellectual, aesthetic and emotional, as well as productive, capacities. Society was therefore conceived in terms of the maximisation of such human capacities not merely as means to material satisfaction but as ends in themselves (Macpherson 1972 p. 21-3; op. cit. 1973 p. 4-6). Consequently, the liberal tradition was modified into liberal-democratic political theory in an attempt to reconcile bourgeois materialist individualism with concepts of social democracy derived from the Western humanist tradition of political thought (ibid.).

Macpherson argues, therefore, that the resulting theory legitimised the developing institutional order with respect to two primary claims of moral justification (op. cit. 1973 p. 6-15). Thus, it was claimed that the capitalist market economy, with the requisite social and political institutions, would ensure, firstly, the equitable maximisation of individual utilities and, secondly, the maximisation of 'extra-utilitarian' human capacities. As in the case of neoclassical economic theory this normative orientation is achieved by adopting a particular conceptual viewpoint on the processes of distribution of political 'rewards' and by neglecting the question of the influence of prior patterns of ownership of resources on these processes.

Consequently, liberal-democratic political theory can be seen as having arisen from a particular viewpoint on the nature of capitalist society and as being complementary to neoclassical economics. Two conceptual components can be identified as particularly important in relation to its normative basis: firstly, the representation of society as a collection of free autonomous and equal individuals and the

denial of a class structure of social relations or any other 'structural' inequalities between different social groups; and, secondly, the representation of the state as embodying the interests of all individuals and as established to protect the freedom of such individuals to exercise their natural capacities. More recently, modifications have been made to this political theory to accommodate the implications of political grouping, producing what is usually called 'democratic-pluralist' theory which retains, nevertheless, the basic orientation of the liberal-democratic tradition.

Democratic-pluralist theory, then, presents a conception of capitalist political society in which power is highly fragmented and shared amongst many overlapping and competitive social groups none of which has any structural predominance. All groups are seen to have an influence in forming socially-binding decisions and, the fact that they share a broad 'consensus' system of beliefs and values encourages the resolution of conflicts between them within established frameworks (Connolly 1969 p. 3; Miliband 1973 p. 4-5). Social classes are assumed to be only one of many clusters of interests in society, if they are recognised at all, counteracted by the capacity of minority groups to influence the political process (Alford 1975 p. 147).

Within this conception the state in capitalist society is seen as an ...

"... institution established in the interests of society as a whole for the purpose of mediating and reconciling the antagonisms to which social existence inevitably gives rise."  
(Sweezy 1971 p. 25).

The state therefore responds to the wishes and demands of all competing interest groups and, since there are no dominant classes, interests or

groups, cannot be biased towards particular interests (Miliband op. cit. p. 5-6). The state is considered, then, as an arbiter - as an 'arena' for debating and resolving inter-group conflicts, or as an 'umpire', setting rules for conflict resolution on the basis of a public consensus (Connolly op.cit. p. 8-13; Dear and Clark 1978 p. 176).

As an institution the state is seen as a multiplicity of overlapping jurisdictions each competing for resources and its bureaucratic process are assumed to be responsive to the political process in their role of equating the supply of political goods with the competing demands of the diverse groups in political society (Alford op. cit.; Macpherson 1973 p. 201-3).

It is notable that 'democratic pluralist' political theory has developed to make use of the analogy with the subjective theory of value in neo-classical economics such that voters are considered to express preferences for political goods and the state is then seen to respond to 'consumer preferences'. More generally, while in neoclassical economic theory rational autonomous individuals maximise their subjective desires in competitive markets and competition results in prices which produce equilibrium solutions, so the dominant model of the democratic political system has adopted the notion of this system as a mechanism for reconciling or balancing a multitude of diverse and conflicting interests and achieving equilibrium through trading outputs of political goods for inputs of political 'resources' (ibid. p. 185-7). Basic assumptions of this model include the rational behaviour of voters and politicians, and free competition between political parties (ibid. p. 188).

Consequently, in this scheme democracy is treated as a mechanism, the essential function of which is to maintain an equilibrium between a plurality of social groups. At the same time the focus of political

inquiry has become the empirical analysis of political behaviour within the pluralist equilibrium framework - in particular, the observable 'preferences' of individuals and groups. But the functionalist orientation of the 'democratic pluralist' model can be seen as producing restrictive implications (Kariel 1970). The model posits a coordinated, healthy social organism with each part functionally adjusted to all the others, free to operate as each member performs its function. Such an abstract, comprehensive behavioural system, based on an assumption of the underlying harmony of the parts of the social whole, is claimed to provide an objective, value-free approach to political analysis (ibid. p. 149-54). But Kariel argues that such analysis betrays an normative commitment supportive of existing dominant values, representing a ... "norm of social health..." and an ... "ideal immanent in reality ..." (ibid. p. 156):

"It offers not an approach but a norm, not a tool for analysis but a theory justifying an existing state of affairs." (ibid. p. 154).

The concern to develop a theory of democracy from the empirical analysis of existing 'democractic' systems results in tendencies which are actually detrimental to the advancement of democracy in its classical sense. For example, in such theory descriptions of present patterns of activity and participation in the equilibrium system take on normative connotations and become 'democratic values' replacing the classical prescription of the politically active and informed citizen (Davis 1970). In this way particular values are promoted in the name of 'value freedom'; ideals are set to correspond to 'reality' thus ensuring social and political stability (ibid. p. 223-6). As Macpherson argues:



"Democracy is held to be consistent with, and even to require, a low level of citizen participation: only so, it is said, is the political system likely to stay in equilibrium. Democracy is reduced from a humanist perspective to a market equilibrium system. And although the new orthodox theory claims scientific neutrality, its value judgement is clear enough: whatever works is right - that is, whatever enables the existing class-stratified society to operate without intolerable friction is best." (Macpherson 1973 p. 78-9).

Preoccupation with the observable political behaviour of individuals and groups also produces important implications for the 'democratic-pluralist' model. The focus on conditions of mobilization of particular groups and individuals for political action and on strategies of influence and outcomes of action in particular observable situations abstracts such overt behaviour from the .."societal and organizational contexts of action.." (Alford op. cit. p. 152) which can be seen as important in shaping it. For example, Lukes (1974) criticizes the pluralist concern with observed decisions and behaviour on two grounds. Firstly, it neglects the exercise of power through the restriction of the political process to 'safe' issues by the creation or reinforcement of social and political values and institutional practices. Control of the political agenda can be non-conscious and non-intentional resulting from socially-structured and culturally-patterned organizational constraints (ibid. p. 16-22). Secondly, it neglects the most 'effective and insidious' use of power as the prevention of actual grievances and conflict through the influencing, shaping and determining of people's perceptions, thoughts and preferences via processes of socialization which persuade people of the legitimacy of the 'status quo' (ibid. p. 23-4). In abstracting from the social, historical and institutional context of political behaviour, democratic-pluralism renders this context unproblematic and beyond scrutiny - and therefore beyond change.

RE. PAGE 255



273 Collieston Avenue,  
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2nd July 1995.

Dear Mr Sullivan,

I refer to your recent letter in relation to the missing page number in my PhD thesis. I can explain that it is a pagination error and not a missing page of text. I apologise for the inconvenience caused by this error.

Yours Sincerely,

I. R. Sanderson

Consequently, democratic-pluralist theory can be seen as neglecting certain important influences on political action and providing a particular viewpoint on the politics of capitalist society. Like neoclassical economics it hypostatizes selected phenomena of capitalism as perceived through a conceptual framework which 'processes out' structural inequalities in the distribution of political and economic power. Considerable criticism has in fact been directed at the assumption or proposition of diffusion of power amongst a plurality of interests. One line of criticism has emphasized the 'biased context' of political power and action pointing to the institutional and resource barriers that hinder or prevent the formation of groups to defend or promote certain interests and values. On the other hand certain organizational elites with command over resources of expertise, class status or wealth monopolise access to political power and restrict the participation of individuals and disadvantaged groups. The resulting 'power elite' have an interest in maintaining the existing distribution of power and wealth and consequently restrict the scope of public policy-making by state institutions to options which will not fundamentally change this distribution (Presthus 1970; Connolly 1969; Alford 1975).

"Viewed as independent systems, then, the private groups that give meaning to pluralism are rarely pluralistic, in the sense of having competing power centers within them. Such groups no longer meet traditional pluralist assumptions, because of the great inequalities in bargaining power that characterizes them. The pluralism that exists is too often restricted to the few powerful organizations that monopolize most social areas. Producer groups, linked fundamentally by an economic interest, dominate, and the less disciplined voluntary organizations rarely compete successfully with them in the struggle for access and influence".  
(Presthus op. cit. p. 288).

Some more radical critics go further and argue that structural inequalities in political power derive from the social context of capitalist society in which the class structure of social reactions is seen as of

fundamental importance. From our perspective these alternative conceptualizations represent partial and selective perspectives on the nature of political systems in capitalist society based upon different value-conditioned viewpoints, containing different normative implications and relating to different social interests. The claim of democratic-pluralist theory to the status of 'value-free science' renders it ideological since a particular value position is being promoted in the guise of value freedom. The assumptions of 'possessive individualism', of diffused political power, of equality of competition between a plurality of interests and of a state instituted to serve the 'general interest' of society indicate the nature of the normative tradition embodied in the dominant ideology.

Therefore, neoclassical economic theory and liberal-democratic-pluralist political theory can be seen as important closely-interrelated elements of the conceptual apparatus of the dominant ideology of our society. Together with other bodies of social knowledge, such as sociology, psychology and jurisprudence, they make up the 'substantive content' of the ideology appropriate to the state's activities in solving practical social problems. As such they provide conceptions or interpretations of the nature of 'social reality' which in their application to practical problems constitute a basis for both changing and legitimizing that reality-as-perceived. Through the examples of economic and political theory I have attempted to indicate the ways in which their pictures of the world are developed and serve to promote the wider legitimation of the capitalist economic and political system. However, the analysis remains incomplete without a consideration of the dominant conception relating to the appropriate utilization of social knowledge: that is, its appropriate mode of application to the solution of social problems.

#### 6.4 A Conception of Knowledge Utilization

With the changing nature of capitalist industrial society this component of the dominant ideology would appear to have become increasingly important and influential. I have presented the argument that as the state has become increasingly involved in economic management, in the production activities associated with the provision of 'collective consumption goods', in the activities required of the 'welfare state', so there has been an increasing requirement for institutionalized production and decision rules for these activities in a domain 'above' (but still related to) that of social interests and power relationships which are manifested in the political process. As this 'technical domain' has increasingly overlain the political so the question of the use of social scientific knowledge has become more problematical since the establishment of decision rules relies heavily on such knowledge. Therefore, in order to carry out its functions the state has needed guidance on the appropriate modes of application of social scientific knowledge within this 'technical domain'. But, at the same time, it has required developments in legitimizing frameworks to justify both its expanded activities and the procedures adopted and applied in the 'technical domain'.

Consequently, it can be suggested that the changing character of the state has been reflected in the changing nature of the dominant ideology, with an emergence to a pre-eminent position, of a 'technocratic region', relating to knowledge utilization. Such a component would remain closely inter-related and inter-dependent with the other ideological components considered above (ie the positivist conception of knowledge development and economic and political theory) but nevertheless can be seen as increasingly providing the major framework of

discourse in relation to the policy activities of the state. I shall therefore now consider the characteristics of this component.

The development of the technocratic conception of knowledge utilization can be related to the post-enlightenment intellectual tradition, aspects of which I have already examined as the context for the emergence of social theory within the positivist epistemological framework. The basic notion underlying this conception is traceable back to the Platonic problematic of assimilating power and knowledge and developing a science of politics grounded in theoretical knowledge of true propositions but oriented towards the transformation and control of society (cf. chapter 2 ). In the mid-seventeenth century this theme was developed by Hobbes who proposed a science of human behaviour which reflected the shift in philosophical thought taking place in the context of an emerging capitalist-industrial system. McCarthy (op. cit. p. 4) outlines the orientation of Hobbes' work as follows:

"Given a correct understanding of the laws of human nature, it would be possible to establish once and for all the conditions of a proper ordering of human life. The classical instruction in leading a good and just life, the formation of virtuous character, and the cultivation of practical prudence were to be replaced by the application of a scientifically grounded social theory, by the production of the conditions that would lead to the desired behavior according to the laws of human nature. In this way the sphere of the practical was absorbed into the sphere of the technical. The practical problem of the virtuous life of the citizens of the polis was transformed into the technical problem of regulating social intercourse so as to ensure the order and well-being of the citizens of the state."

Consequently, a new 'technical' concept of reason began to emerge and the development of science became tied to the standards of observability, as the basis for the development of true knowledge, and applicability, as the primary justification for scientific activity (cf. Dreitzel op. cit. p. 166). These standards can be seen as closely inter-related. On the one hand, the application of scientific knowledge in the

direction of human progress was justified with reference to the objective law-like nature of that knowledge derived from pure observation. On the other hand, the orientation of the sciences of society towards the production of law-like knowledge can be related to political and social trends, particularly the development of the secular state with its emerging rationalizing activities in the economic and social spheres involving the application of knowledge free from the ignorance, superstitions and dogmatism which were seen as characterizing the 'old' forms of political activity.

The development of positivist philosophy can therefore be seen as confirming and consolidating the post-enlightenment tradition. Habermas (op. cit. 1976A) argues that the achievement of modern positivist empirical science is denoted by two essential characteristics. Firstly, its 'affirmative achievement' lies in the commitment to producing predictive laws which reveals an interest in technical control over the objects or objectified processes of nature and society (ibid. p. 334; cf. above ch.2 ). Secondly, its 'critical achievement' lies in the argument that through the application of the scientific method to the study of social phenomena involving rigorous avoidance of normative considerations, the influence of pseudoscience, ideology and dogma on political action can be eradicated. Value-neutral scientific reason is thereby elevated to a standard against which all other claims to the guidance of purposive action can be rejected as ideology (ibid. p. 334-5; McCarthy op. cit. p. 5-6). But through these achievements positivism betrays a commitment in favour of a particular interest or 'value'. 'Scientific' questions are those restricted to the refinement of means for the purposive-rational pursuit of ends. Practical questions relating to the selection and justification of ends cannot be answered scientifically (and therefore 'rationally'); only technical questions, relating to the efficient achievement of given

ends, can be answered by science. Therefore, positivism provides a form of 'committed reason' in favour of extending and rationalizing technical control over nature and society. 'Rationality' becomes identified with behaviour in accordance with the technical recommendations of 'value-free' science and a particular value-system is thereby dictated in the name of value freedom (Habermas op. cit. p. 335-40).

Such developments in thinking about the relationship between knowledge and action, or about appropriate modes of knowledge utilization, can be related to trends in the process of capitalist economic and political development. Two such trends during the present century have been of particular importance: firstly, increasing state intervention to secure the stability of the capitalist system; and, secondly, a growing interdependence of scientific research and technology which has turned 'science' into a leading productive force (Habermas 1971 p. 100). As indicated above the increasing involvement of the state in productive activities has resulted in a growing orientation towards the solution of 'technical' problems relating to the economic system's stability and growth as given ends. This has produced increasing demands on social science to provide appropriate knowledge which can be applied in the solution of such problems - hence the orientation towards 'value free' knowledge and towards the production of technical decision rules concerned with evaluation of alternative means (eg optimisation techniques). As the social sciences have been increasingly related to the activities of government so they have become more important as productive forces and this has provided a basis for the legitimization of the expanded role of the state with reference to its emergent 'technical domain' of activity. Politics is portrayed as a purely technical activity concerned with instrumentalist decisions on the means to achieve given ends in the rational administration of the economic system; public discussion of practical questions concerning



alternative ends and values is depicted as irrational if not irrelevant; the development of the social system is presented as essentially dependent upon the logic of scientific-technical progress. The operation of political power is therefore reduced to a technical construct - involving the rational choice of means on the basis of objective scientific information dispensed by impartial experts for the use of politicians (ibid. p. 101-6; Fay 1975 p. 44-6).

This technocratic conception of knowledge utilization can therefore be seen as arising in response to the changing nature of the modern state, particularly the increasing importance of a 'technical level' of policy-making relative to the 'political level'. Nevertheless, to argue that the traditional framework of the exercise of political power has been overlain by a 'technical domain' of the exercise of rationality is not to argue that the policy-making process can be reduced to a purely technical construct. However, the technocratic conception, does just this; it focusses on the emergent technical domain, abstracts it from the underlying political basis and hypostatizes it as 'reality'. As such it can be seen as ideological, serving to divert analytical attention from the power political bases of the state's policy making activities and, therefore, to legitimize such activities as well as providing a justification for low levels of political participation amongst the majority of the population (Habermas op. cit. p. 104-12).

Moreover, this 'technocratic consciousness' provides a modern ideology for capitalist society which has arguably become increasingly prevalent somewhat at the expense of the ideological components provided by, for example, neoclassical economic and democratic-pluralist political theory. Although the latter can, as discussed above, be seen as still providing important 'legitimatory frameworks', the changing

nature of the capitalist state has produced a requirement for the new technocratic component relating to the application of scientific knowledge in the guidance of political action. To be rather more specific the implications of the technocratic ideology can be considered by examining in more detail the prevailing conception of the appropriate relationship between social scientific knowledge and public policy-making.

The last twenty years, in particular, have witnessed an increasing predominance of the view that the means to the solution of our social problems lies in the application of 'better' and more 'relevant' social scientific knowledge and information in the process of public policy formulation. Moreover, the development of this belief has resulted in many attempts to 'improve' the policy-making process through the increased orientation of social scientific research towards the production of 'policy-relevant knowledge' and technical aids to decision-making. Many observers have noted these trends. For example, Nelkin (1979B p. 106) argues that since the late 1950's there has been ...

" an increased integration of scientific knowledge as an instrument of public policy, and a growing ideology that science is a model for rationality in public affairs."

Straussman (1976 p. 130-1) and Gunnell (1976 p. 33-4) both point to the trend during the 1960s towards disillusionment with the apparent irrelevance of much 'pure' social science research to pressing social problems and a greater insistence on 'relevant' research to provide better information for application in the planning process. Dallmayr (1981 p. 523-4) highlights Easton's presidential address to the American Political Science Association in 1969 as a landmark in this trend. In this address Easton criticised the focus on 'abstract

explanatory schemes' and the 'simple cultivation of science for science's sake' and urged a revolutionary realignment in political science towards the solution or amelioration of major social and political problems based on the 'findings of contemporary behavioral science'. Since the late 1960s there has indeed been an increasing concern, within political science, with 'policy analysis' - with the generation of information and knowledge which can be applied so as to..."improve the basis for policy-makers to exercise their judgement." (Rhodes 1979 p. 23).

These trends reflect an intellectualist and rationalistic view of the role of social scientific knowledge in public policy making which is encapsulated in Dror's definition of 'policy sciences':

"Policy sciences is concerned with the contributions of systematic knowledge, structured rationality and organized creativity to better policy making. It constitutes a main effort to reassert the role intellectualism and rationalism in guiding human destiny ..... policy sciences is essential for improvement of the human condition and, indeed, for avoidance of catastrophe." (Dror 1971 p.ix)

The intellectualist policy science model therefore assumes that social science is essential to making sound policy decisions both in terms of the formulation of improved procedures for decision making and in terms of increasing scientific knowledge and information that makes intelligent and rational decisions possible (Gunnell op. cit. p. 30-1). Knowledge gained from social science will permit the control and management of society to promote a rational social structure congruent with the needs and wants of its members (Fay 1975 p. 19). In this view political considerations tend to be seen as obstacles to the progressive rationalization of decisions and actions; the utilization of knowledge is taken as a technical problem of linking the point of

knowledge production to the point of action (Ezrahi 1980 p. 111-2; Kerr 1981 p. 484). As Nelkin (1979B p. 106) argues:

"The well-structural logic, clarity and precision of scientific knowledge appeals to policy makers as a way to enhance the quality and efficiency of the decision-making process. Scientific knowledge has, according to many analyses of advanced industrial society, assumed increased importance as an 'apolitical' basis of policy formulation."

Of course, this implies that behind this view of the role of social knowledge in public policy formulation lies a particular view of the nature of such knowledge. In particular, the model assumes that the ability to act competently in the context of some activity is a function of an objective understanding of that activity (Gunnell op. cit. p. 35). Indeed, in this model we find many of the positivist assumptions which underlie the dominant ideological conceptions of our society: knowledge developed independently from its application, standing in an abstracted, intellectualist relation to practice, permitting social control through its quantitative, predictive laws (ibid.; Fay op. cit. p. 20-1; Nelkin 1979B p. 108). Consequently, a particular conception of 'policy-relevant knowledge' emerges which venerates the precise quantitative laws of the natural experimental sciences as the epitome of rationality. This view is expressed, for example, in many of the studies in Nagel (1975) who argues that..."the quantitative and computer science tools that are ultimately associated with mathematics..." can provide an antidote to ..."evaluative gut reactions, armchair speculation, and isolated historical anecdotes" (ibid. p. xiii). He goes on to argue that:

"Physical and biological science to some extent provide models to emulate in the development of mathematically scientific laws, provided one always considers the differences in the behavioural instability of people as compared to physical or biological objects." (ibid.).

This theme is developed by Montgomery (1975 p. 221) in the following terms:

"The techniques of mathematics and natural science that are likely to be useful in policy studies are primarily quantitative ones. Hence whenever we deal with social variables, such as national income or poverty level, that by their nature require quantification, we have available a battery of techniques and methods that have proved themselves useful in science and engineering. What may be of profound consequence moreover, is that natural science may demonstrate the necessity and possibility of quantifying concepts traditionally held to be non-quantifiable. The quantification will give these concepts operational meaning and thus enable them to have increased impact on actual decisions."

Finally, Dror (1971) refers to 'weaknesses' of behavioural sciences which he considers to be obstacles to the development of 'policy sciences'. The standard against which 'weakness' is assessed is implicitly that provided by the mathematical formulations of the natural sciences; the exception, he argues, is economics which has been successful in providing policy-relevant knowledge:

"Well-recognized reasons for the special nature of economics include the different intellectual history of economics, which has been more policy-oriented; the susceptibility of large parts of its subject matter to quantitative treatment; the reductionability of many of its variables to a limited number of main aggregate categories which are operational and measurable; and the relatively simple characteristics of some main category interrelations which permit quite isomorphic simulation of important aspects of economic phenomena in modern societies by compact and exercisable models." (ibid. p. 8)

The intellectualist policy science model of the relation between social knowledge and public policy formulation can therefore be seen as intimately related to the positivist theory of knowledge. Indeed, such a conception of the relation between knowledge and action is implied in the positivist epistemology. Moreover, when this conception is elaborated as a means to understanding the process of policy-making

in our society it, in turn, implies a particular model of the political system (cf. Fay op. cit. p. 15-16). This model produces important implications for our views about the nature of both valid political argument and appropriate political institutions.

Firstly, as regards the nature of political argument the policy science model implies a view of the increasingly 'scientific' and 'technical' nature of such argument as political decisions becomes less a matter of 'conjectural, arbitrary and emotional' debate in relation to imprecise objectives, and more a matter of the technical application of reliable social scientific knowledge to the analysis of means to achieve defined ends (ibid. p. 22-4). Within this conception there has been a progressive extension of the rationalization of politics to cover the ends, as well as the means, of political action. At the most basic level social scientific knowledge in the form of lawlike regularities and scientifically-tested predictions provides technical criteria to guide selection of means to achieve given ends which are beyond the realm of rational discussion (cf. Habermas 1971 chap. 5, 1976A p. 340-6; McCarthy 1978 chap. 1). At the next level the ends of political action are subjected to decision-theoretic techniques which provide a formal rationality but which do not permit of rational discussion of the content of goals. (ibid.)

However, higher levels of rationalization have been introduced to incorporate social goals. For example, game-theoretic approaches rationalize values in terms of successful self-assertion to secure survival and risk minimisation and therefore begin to introduce an imperative into decision-making systems (Habermas 1976A p. 343-4). And the highest expression of the technocratic consciousness embodied in the policy science model is to be found in the notion of a

.."cybernetically self-regulated organization of society..." (ibid. p. 346) with decision-making in self-programming feedback systems guaranteeing the fulfilment of objectively-necessary system goals (eg stability, adaptability, growth etc). Such goals, rationalized in terms of necessity, are therefore again placed beyond the realm of rational public discussion (ibid. p. 345-6; McCarthy op. cit. p. 10-11). At whatever level the rationalization is applied the implications for the view of the nature of political argument are the same; politics is reduced to the technical application of social scientific knowledge to the determination of means to achieve given ends.

Such a reduction produces important implications for views on the nature of political institutions, in particular on the respective roles in the policy-making process of politicians and 'scientific experts'. Within the policy science model it is argued that the increasing importance of social scientific knowledge to rational political argument and policy making necessarily implies a shift in power from politicians to the 'knowledge elite' - to those who have control over the scarce resource of scientific knowledge (Fay op. cit. p. 26; Straussman 1976 p.150-1). Policy formulation is seen as increasingly dominated by experts who monopolize the difficult technical choices which are involved. Therefore, the traditional role of political institutions is seen as progressively eroded by 'societal guidance', on the basis of expert technocratic counsel, in the form of planning and bureaucratic management (cf. ibid.; Melanson 1972, Nelkin 1979B p. 107-8). This view is evident, for example, in Galbraith's analysis of 'advanced industrial society' in which, he argues..." the educational and scientific estate is becoming a decisive instrument of political power." (Galbraith 1974 p. 296). He goes on to suggest that:

".. it is safe to say that the future of what is called modern society depends on how willingly, rationally and effectively the intellectual community in general, and the educational and scientific estate in particular, assume responsibilities for political action and leadership."  
(ibid. p. 373)

This perspective achieves its most mature state in the concept of the 'post-political', 'post-industrial' society managed equitably by the knowledge elite through the application of social science, no longer subject to 'irrational' political conflict and struggle over scarce resources (Hennessey and Peters 1976 p. 115; Dahlstrom 1976 p. 6-7).

The fundamental problems with the technocratic model of knowledge utilization derive from its location within the positivist philosophical tradition - indeed, from its development as the political manifestation of the positivist enterprise. On the basis of our critique of the ideological nature of social scientific knowledge developed within the positivist epistemological framework, it is obviously not possible to uphold the notion that the rationality of the public policy-making process derives from the application of objective social knowledge to guide political action. Since, I have argued, according to positivist canons of rationality, social theorizing must be done 'irrationally' then it can have no 'a priori' warrant to provide criteria for rational action. The criteria which it does in fact provide, in the form of knowledge about social phenomena and procedures for decision-making, should be analysed in relation to the nature of the value commitments and ideological frameworks which arise from the process of production of social scientific knowledge within our particular social context. In general terms this amounts to an orientation towards the preservation of basic social institutions and structures of economic and political power through the circumscription of the scope of 'rationality' in political action.



More specifically, the positivist segregation of facts and values, translated into the technocratic distinction between means and ends, produces an instrumental 'technological rationality' which necessarily embodies a political commitment. The assumption that only questions concerning the best means to achieve given ends are amenable to scientific solution produces the view that debates about political ends, principles, ideals and basic values are necessarily 'irrational'. Consequently, political discussion is seen as restricted to technical questions about the efficiency and economy of means in relation to given ends (Fay 1975 p. 61; Habermas 1976A; Cotgrove 1975). But the effect of this is to impose by default a particular value-system in the name of value-freedom and this 'technocratic' value-system is inherently conservative. To label as rational only that action which is in accordance with the technical recommendations of so-called value-free science is to outlaw discussion of alternative political and social goals and to give credence only to those analyses which implicitly accept the social and institutional structure, and the dominant values, of our existing society (Habermas op. cit.):

"The subjectivistic reduction of the interests which are decisive in the orientation for action to 'sentiments' or 'perceptions', which cannot be rationalized beyond that, is a precise expression for the fact that the value freedom central to the technological concept of rationality functions within the system of social labour, and that all the other interests of the practice of life are subordinated for the benefit of the sole interest in efficiency and economy in the utilization of means. The competing perspectives of interest, hypostatized to values, are excluded from discussion." (ibid. p. 342)

That certain values are imposed by default can be established from the argument that means and ends cannot (like facts and values) be radically distinguished. All possible means are ends relative to other means required to achieve them so the choice between means, as a species of

moral statement, cannot be politically neutral (Fay op.cit. p. 51-3). Moreover, the choice of 'best' means requires some criteria and the use of those of economy or efficiency cannot be neutral with respect to values because the specification of the content of these criteria (eg money, labour, time) must embody certain values (ibid. p. 50).

Further, the technocratic conception implies a particular view of political participation. If political activity is seen as a question of solving technical problems relating to means, with discussion of ends or values of society dismissed as 'merely subjective', then the role of the general public in politics and, indeed, of elected politicians, becomes subordinated to that of the technocrats, experts and planners. This conception can therefore be seen as providing a justification for low levels of political participation and debate which, again, serves to promote the stability of existing dominant values and social arrangements.

The technocratic idea that power in advanced capitalist democracies has passed to experts because of latter's command over the increasingly important and scarce resource of scientific knowledge can be seen, then, as representing a partial and selective conception of policy-making systems. Notwithstanding the growing importance of such knowledge as a productive factor and the increase in 'rational administration' by the state on the basis of 'technical' decision criteria, the technocratic conception of knowledge utilization tends to focus on and abstract this 'technical domain' of state activities from the wider political context thus neglecting the operation of political influences on policy formulation.

The importance of such political factors in public policy making has been asserted by analysts in critiques of the 'policy science' models.

For example, Ezrahi (1980) emphasizes the primacy of political activity which he defines as..."the creation and preservation of order while pursuing practical objectives which are usually incommensurate, inconsistent and ambiguous" (ibid. p. 131). Given this nature of political considerations he argues that scientific knowledge is likely to be used more for its political value in legitimizing decisions than for its intellectual value in informing them (ibid. p. 127). He refers, as an example, to the controversy over the nuclear test ban treaty during the 1960s and quotes one commentator's conclusion to the effect that ...

"..the major importance of scientific advice lay not so much in that it provided the basis of decision as that it helped create a political consensus in favour of the decision. In the process of acquiring scientific advice the prestige and presumed objectivity of scientists were mobilized to ascribe to the treaty a certain aura of technical legitimacy." (ibid. p. 126)

Moreover, Ezrahi sees certain incompatibilities between the nature of scientific knowledge and the information requirements of policy makers (ibid. p. 127-8, 130). This theme is also taken up by Higgins (1980) who argues that politicians and social scientists have different orientations and needs so that the technical quality of social research is largely irrelevant to its political usefulness. (ibid. p. 201-2). For examples, whereas the social scientist requires specific goals and objectives in advance of action, the political process is characterized by imprecise and ambiguous goals because of political uncertainties and conflicts, and advantages to politicians of retaining a degree of ambiguity (ibid. p. 202). Consequently, there has been a neglect by social scientists of ..." the political viability of their researches" (ibid.).

However, despite these difficulties there has nevertheless been an ... "increasing importance attached to 'expert knowledge', 'scientific' problem-solving and sophisticated research methodology" ... (ibid. p. 199) which suggests an important legitimizing role for such knowledge and techniques, and for the 'policy science' model itself. This can be related, as argued above, to the increased requirement for the state to become involved in planning and bureaucratic management, especially directed at the problem of maintaining the stability and growth of the economic system. The increasing importance of this 'technical domain' of state activity, then, has resulted in the emergence of a 'modern' ideological framework which legitimizes the state with reference to science and 'technique'. The liberal democratic-pluralist political ideology, which legitimizes the state primarily by presenting it as the embodiment of the 'general interest' of an essentially conflict-free society, is therefore refined in the emergent 'technocratic ideology'. In this framework the state is still presented as serving the general interest but now this is achieved through the application of scientific rationality rather than through the political process; indeed, in this ideology politics is reduced to rational technocratic guidance. But this ideological framework can thereby be seen as abstracting the technical aspect of policy formulation from its political context and, consequently, as diverting analytical attention from underlying structures of power and dominance. It provides, then, a conception of knowledge utilization with inherently conservative implications promoting acceptance of prevailing values and social relations by defining value questions and politics as 'irrational', and providing bureaucratic elites within the institutions of the state with powerful 'social technologies' (eg decision techniques such as CBA, PPBS) through which policy decisions can be legitimized on the technical level.

## 6.5 Conclusion

It is possible to hypothesize, then, that this 'technocratic ideology' has a prevailing contemporary influence upon thinking about social and technological development in our society. As a basis for an attempt to examine the validity of this proposition it is appropriate to summarize the major themes of this ideological framework. I have argued that the dominant ideology contains conceptions of the appropriate mode of development of social knowledge, of the nature of the content of our social world, and of the appropriate mode of utilization of such knowledge to influence the process of social development. In their mutual interaction and interdependence these components can be seen as generating certain fundamental normative themes.

Firstly, there is an underlying liberalism in evidence particularly in the models of the social world provided by orthodox economic and political theory. Such models, developed according to positivist epistemological tenets are based primarily on the observable and measurable phenomena of capitalist society abstracted from their institutional and historical context. Market exchange processes are abstracted from various important processes influencing the distribution of income and wealth; aspects of political behaviour are abstracted from processes behind the distribution and exercise of political power. What emerges is a view of society as composed of free, autonomous rationally behaving individuals, maximising their self-interest in a process of equal exchange in the market, and thereby producing tendencies towards an equilibrium which optimises individuals' and society's welfare and which brings about social harmony and balance. The social mechanisms of market exchange and democracy therefore achieve a balance between individuals' preferences for economic, political and social 'goods' and the provision of economic, political and social 'outputs'. It is

the 'autonomous preferences' of individuals which have prime importance in this scheme, not to be interfered with, providing the basic impulse for economic and political change, and to be protected by the institutions of the state. Groups of individuals may compete for scarce resources but such competition is mediated by the state established in the general interest of society as a whole. No fundamental deep-seated social conflict is seen to exist; the concept of social classes with conflicting interests is not incorporated into social analysis. And, finally, social change is conceptualized in gradualist, quantitative terms, the mechanistic paradigm unable to accommodate the idea of fundamental qualitative institutional change.

The second theme is provided by a rationalism which is epitomised by 'technocratic rationality'. Embodied in this rationalism is a pragmatic notion of the manipulability of nature and society and a mechanistic notion of the partitionability of the world producing a disaggregated and sectoral approach to its analysis. Technocratic rationality assumes the primacy of instrumental reasoning concerned with the achievement of given ends through the selection of the best means on the basis of objective, 'value-free', social knowledge. Rationality therefore applies only to the consideration of means which are radically distinguished from ends and values, the consideration of which must be 'subjective' and, therefore, irrational. Means are consequently abstracted from the ends and values which they serve and imply and this is reflected, for example, in abstraction of technological developments from their social and institutional contexts. Moreover, technocratic rationality implicitly imposes certain values, particularly those of 'efficiency' and 'economy', in the idea of value-free selection of the 'best' means. And, at a higher level, it implies a conception of political society which again involves the imposition of a particular

value-system in the name of value-freedom. 'Progress' is seen to involve the replacement of politics with rational technocratic guidance involving instrumental reasoning applied by experts whose influence on social development therefore increases at the expense of that of politicians. There arises the ideal of the 'post-political' society managed equitably by expert technocratic counsel, not requiring a high level of citizen participation and therefore no longer subject to 'irrational' political disputes and antagonisms.

By removing the goals and values of society from the realm of rational discussion, technocratic rationality  
 A can be seen as producing an implicit acceptance of a materialist imperative; such a materialism constitutes a third major ideological theme. The priority afforded to the process of capital accumulation within the capitalist economic system and the functions of the state in relation to the maintenance of social stability through the establishment of the conditions necessary for continued accumulation and growth produce a pervading materialist context for the operation of social processes in our society. The expansion of material outputs is an essential component of the 'raison d'etre' of advanced industrial societies. Moreover, the orthodox perception of social goals and values in our society is heavily conditioned by the economic orientation of the dominant ideological framework. Neoclassical economic theory abstracts commodity exchange processes as the essence of the economic system and defines social welfare in terms of goods and services which can be exchanged in the market. Progress - the expansion of social welfare - is therefore defined in materialist terms, and materialist goals become reified, unchallengeable within technocratic rationality. More specifically, progress is seen to involve the extension of rational technocratic guidance to promote

the development of technological means to achieve expansion in the output and consumption of material goods and services, and to balance the demands of all individuals and social groups for such material outputs and resources so as to maintain social harmony.

We have, therefore, now arrived at a conceptual framework comprising a set of hypotheses about the nature of social scientific knowledge, the basis for its 'rationality', and its role and influence in debates and decisions about public policy issues. In particular, I have produced a conception of ideological knowledge and of a 'dominant ideology' and its major normative underpinnings in our society. This conception now provides a framework for examining a specific public policy issue - that concerning the development of nuclear energy - with a view to, firstly, making an assessment of the 'usefulness' of this conception and, secondly, attempting to provide some insights into the present state of the debate about the implications of proceeding with (or not proceeding with) nuclear power as a possible solution to the 'energy problem'. This analysis will be the concern of the second part of this thesis.



## PART TWO: Ideology and the Nuclear Power Debate

"Abundant energy is perhaps the most essential need of an industrialised society. Nuclear power can meet this need and surely will go on to do so."  
(Hill 1981 p. 519)

"While delay is an easy option, the risk and high cost to the economy in terms of loss of output, unemployment and social unrest, that would follow any severe or prolonged energy shortage would seem to be too high a price to pay for appeasing the opponents of nuclear power, if indeed this is possible.....

Governments should then, wherever possible, take what steps are readily available to increase the rate of construction of nuclear stations; to promote the use of electricity and nuclear power...." (Greenhalgh 1980 p. 117).

"The as yet unsolved problem of waste management and the possibly unsolvable (in an absolute sense) problems of catastrophic releases of radioactivity and diversion of bomb grade material combine to create grave and justified misgivings about the vast increase in the use of nuclear power that has been widely predicted. The wisdom of such an increase must at the present time be seriously questioned." (from the Statement of the 23rd Pugwash Conference quoted in Lovins 1975 p. 9)

"(N)uclear power involves a set of unresolved physical dangers,.... it propels a dangerous social instability both domestically and internationally, and..... it is not relevant to the main problems of energy supply facing Britain." (Prior 1980A p.8)

Such statements as these provide some indication of the degree of polarisation which has developed in the debate about the need for, and desirability of, the development of nuclear power as a contribution towards the solution of the energy problems which we face now, and in the anticipated future. The strength of feeling and depth of controversy which has emerged over this issue can be seen as a function of the 'special' character of nuclear technology compared with other types of technology of which we have experience. There are perhaps two primary aspects of this special character (Bickerstaffe and Pearce

1980 p. 311-2). Firstly, civil applications of nuclear power developed out of an original military programme and there are necessary continuing linkages with a realm of technological application of horrendous destructive capacity. Secondly, the 'social costs' associated with nuclear power potentially achieve a scale of collective impact not found in other fields of technological development. For example, the potential impact of a reactor accident is many orders of magnitude worse than the severest consequences of non-nuclear technologies (setting aside the question of probabilities).

This latter characteristic is of some considerable importance to the debate about nuclear energy. The general point has, as we have seen, been made by Wolf Häfele (1974). He argues that nuclear power is representative of a scale of technological development, which we have now achieved, the implications of which impinge upon "...the widest determinants of our normal existence." (ibid p. 317). Therefore, the scale of the potential collective social costs, in relation to safety, environmental, social and political implications, is such as to pose threats to some of the fundamental bases of our social existence. In this context, Häfele argues "... the public concern about nuclear power is not unfounded" (ibid); Bickerstaffe and Pearce (op. cit.) go further and suggest that opposition is 'legitimate'. An important corollary of this characteristic of nuclear technology is a limit on the extent to which we can learn from experience the actual magnitude of the social costs involved due to the obvious inapplicability of the 'trial and error' approach and to the inappropriateness of analogies with other highly engineered systems whose potential risks are qualitatively different (Häfele op. cit. p. 313-4; Lovins 1975 p. 12). Consequently, the knowledge which can be brought to bear upon the controversy over nuclear power is subject to certain limitations and this has important consequences. In particular, it can be seen as

reducing the potential basis for consensus, aggravating the controversial nature of the issue.

Moreover, a parallel corollary of this 'special' nature of nuclear technology makes the situation even more convoluted. It is now widely accepted that debates about technological developments are underlain by questions relating to value systems relevant to what is seen as a 'desirable' society; such arguments were considered briefly in chapter one (see p.48 ). The existence of divergent value systems, then renders disputes about social and technological change extremely complex and difficult to resolve due to disagreement on the definition, magnitude and evaluation of costs and benefits. However, this dimension of the controversy would appear to be rendered substantially more important in the case of nuclear technology because the potential scale of its impacts is so great in relation to our social existence. Many who emphasise the possible number of casualties from a reactor accident, possible long-term hazards of nuclear waste, possible implications for civil liberties etc., may be less concerned with statistical calculations of low probabilities than with the ethical and moral implications of potential consequences (cf. Taylor 1980). Therefore, the strength of such quite legitimate ethical and moral concerns about the impacts of nuclear technology may greatly overwhelm the consideration of the 'facts' relating to the magnitude of such impacts, 'facts' which, in many cases, (as argued above) are indeed based upon a limited foundation.

On the question of the development of nuclear energy, then, we have a recipe for a particularly intricate and intractable controversy, in which cognitive and evaluative structures operate in a complex interrelationship. As a basis for an attempt to investigate the

nature of this interrelationship it will be useful to outline in broad terms what is at issue in the debate over nuclear energy and the nature of the major arguments. Basically, the controversy centres on the question of what are, in the widest sense, the costs and benefits to society associated with the development of nuclear power. However, questions of magnitude form only part of the debate. More fundamental are disputes which arise due to differences in values concerning, for example, just what are the relevant costs and benefits. What impacts are to count as 'costs' and which are to count as 'benefits'? The problem is that when value systems differ one person's 'benefits' may be another person's 'costs' so there may be little common ground on which agreement can be reached. Indeed, the problem extends to the actual identification of impacts; such an identification is contingent upon the employment of some conceptual framework concerning the interrelationships between technology and society and the existence of alternative frameworks or paradigms or ideologies produces problems of incommensurability in the debate.

Such effects are largely implicit and invisible. Perhaps the most obvious influence of values on the debate concerns the weighting of different costs and benefits and the establishment of 'trade-off functions'. Together with disputes about magnitudes of costs and benefits and about appropriate units of measurements, this area of disagreement constitutes perhaps the most visible part of the controversy. For example, for David Pearce (1980A) the 'energy equation' involves trading the economic benefits of nuclear power compared with alternative energy solutions against the alleged higher social costs of a nuclear future. The major part of the controversy concerns the relative magnitudes of the economic benefits and the social costs and the weighting of these magnitudes. But adherence to alternative value

systems can result in the rejection of this framework; for example, those who deny the benefits of economic growth will see a nuclear future as all cost and no benefit (ibid. Pearce and Nash 1981 p. 18). In addition there is the problem of identifying what the economic impacts of nuclear power actually are; we have seen (cf. Chapter 3) that there is no possibility of objective economic knowledge and it is possible to adopt hypotheses which point to a negative economic impact for nuclear power.

For the purposes of exposition, then, I will first consider arguments (in Chapter 7) relating to the economic implications of nuclear power, the predominant view being that here lies the benefits against which any social costs must be offset. Then, in Chapter 8, I shall look, in turn, at safety, environmental, social and political implications and consider arguments which, to a large extent, relate to the measurement, magnitude and weighting of the 'social costs' involved. The emphasis in these two chapters will be on developing outline positions of supporters and opponents in relation to the primary issues with the intention of presenting what might be seen as 'typical' or 'characteristic' stances rather than exhaustive representations of all possible arguments. It is hoped that the conceptual advantages of this approach outweigh the disadvantages due to synthesis and aggregation. Finally, in Chapter 9, I shall examine certain aspects of the debate, focussing primarily upon stances which favour the development of nuclear power, with a view to assessing the extent to which the arguments developed in chapters 2 to 6 provide a meaningful conceptual framework for gaining an understanding of the complex interrelationship between the cognitive and evaluative dimensions of the debate.

## Chapter 7: The Economic Benefits of Nuclear Power

### 7.1 Introduction

There are two major interrelated economic issues at stake in the nuclear debate. The first concerns the extent to which nuclear power is necessary to prevent future shortages of energy and therefore, by keeping the cost of energy down, to guarantee the continuation of economic growth. Accepting, for arguments' sake, that economic growth represents a benefit the central question becomes: what are the economic benefits of nuclear power measured in the form of the future increase in gross domestic product which would necessarily be foregone if nuclear power were not developed? (Pearce 1979A p. 35). The second related issue concerns the extent to which the cost of nuclear generated electricity is less than that of electricity generated from other sources and, consequently, the extent of the economic benefit to be derived from generating electricity from nuclear reactors as opposed to other sources. Again the benefit is in the form of GDP otherwise sacrificed. Obviously, the issues are extremely complex and I shall attempt only a brief survey of the arguments pro and anti.

## 7.2 Avoiding an Energy-Constrained Future

The argument in support of nuclear power as the means to avoid an energy-constrained future can be broadly outlined. The population of the world is increasing rapidly and living standards are rising. While standards in developed countries will continue to increase, Third World countries want to close the 'development gap' at the same time as supporting rapidly rising populations. The increases in food supply required will need higher energy inputs (Greenhalgh 1980 p. 13-21; Jones 1980A p. 18; Hill 1976 p. 3; Tombs 1979 p. 116). It is imperative that economic growth be maintained and indeed encouraged in order to maintain stability and provide development in poorer countries:

"There can.... be little doubt that increasing economic growth has been and is the only means of providing the large majority of the world's population with those goods and services which were once the prerogative of the few. Any alternative may lead to the introduction of a dirigistic economy with an associated police state, or at the international level a conflict between the underdeveloped and the industrialised countries."  
(Greenhalgh op. cit. p. 3)

Since there exists a well established empirical relationship between economic growth and energy consumption, a relationship which cannot be completely decoupled, continued growth must mean increasing energy consumption (Jones 1980A p. 18; Greenhalgh 1980 p. 4-7; Hill 1977; Bethe 1978 p. 91). There is a limit, then, on the extent to which conservation and energy efficiency measures can reduce the rate of growth in energy consumption in a healthy economic climate due to technical and economic factors and problems relating to consumer choice; in a context of low growth investment in energy saving would be even more constrained. Moreover, there are severe limits on the extent to which conservation measures can reduce the growth of energy

consumption in less developed countries (Jones op. cit.; Greenhalgh op. cit.; Weinberg 1980 p. 32). It is even suggested that conservation represents a waste of resources compared with alternative investments (Tombs 1978 p. 3, 1979 p. 116).

Because of technical, economic and environmental problems renewable sources of energy will, it is argued, be able to make only a limited contribution to energy supplies in the foreseeable future, probably little more than 10-12% on a world scale by the end of the century and less than 15% in 2020 (Jones op. cit. p. 18-19). Due to problems of high capital costs and variable output investment in such sources as solar, wind and wave energy is likely to be 'uneconomic' (Tombs op. cit.).

At present rates of consumption oil and natural gas reserves can last only a limited time, at the most about 30 years, perhaps up to 50 years in the case of natural gas. As prices rise more marginal sources will be used and greater exploration and enhanced recovery will increase supplies but it is argued that this will have relatively little impact (Greenhalgh op. cit. p. 45-6; Bethe op. cit. p. 85-7). Moreover, such fuels should be reserved and conserved for premium uses such as transport, chemical feedstocks and even synthetic protein: "we should not then consider burning hydrocarbons; we may need to eat them" (Greenhalgh op. cit p. 19). Although coal reserves are considerable they are poorly distributed in relation to areas of demand thus creating a trade problem, and will become increasingly expensive to mine. Moreover, occupational risks from coal mining are high and there are likely to be environmental obstacles to the full exploitation of coal resources. Nevertheless, coal is seen as indeed making a significant contribution to satisfying future energy demand (up to about a quarter of world primary energy supply by 2000-2020), but given that it will



have to be used increasingly to substitute for declining hydrocarbon resources, it cannot in itself provide for the growth in demand for electricity (Jones op. cit.; Hill 1976, Tombs 1979).

Indeed, it is envisaged that an increasing proportion of the total demand for energy in the future will be for electricity. Electricity consumption has grown in the past faster than energy demand in general and should continue to grow rapidly especially in developing countries (Greenhalgh op. cit. p.99-101; Bethe op. cit. p. 94-5). Given the advantages of electricity as an energy carrier and the future need to substitute oil and gas, Weinberg (1980 p.32) for example, sees no reason why we should not envisage a predominantly electric future.

Therefore, it is argued by proponents of nuclear power that, in spite of conservation efforts, the growth in energy demand will eventually begin to 'outstrip' available supplies from fossil fuels and renewable sources creating an 'energy gap' or 'shortfall'. This would obviously not appear as a physical gap or shortage but would manifest itself in the form of rapidly rising energy prices and depressed growth. This problem could then present a real threat to the stability of Western economies and to the development hopes of the Third World, and would create international tension due to competition for scarce energy and measures to protect national economies (Jones 1980B p.154; Tombs 1978 p.4). In particular, an 'energy trap' could arise with rising energy prices producing a downward spiral of recession in which falling demand limits the scope for the investment in supply needed to break out of the 'trap' (Greenhalgh op. cit. p. 113-5).

In order to avoid such potential problems, then, it is considered imperative that all energy options open to us are exploited to the

maximum possible extent and with some urgency so as to keep our options for the future open and to minimize the risk of energy shortages and, consequently, constraints on economic growth (Jones 1980A; Weinberg 1980). In particular we must develop nuclear power on a substantial scale since it provides the best prospects for reducing the pressure on other energy sources (releasing coal to substitute for oil and gas) and for stabilizing energy prices (Jones 1980B p. 154-5). In other words, the development of the nuclear option minimizes the risk of constrained GDP growth and therefore provides the greatest benefits in terms of GDP which would otherwise be sacrificed.

In the longer term, moreover, in view of limits to the availability of uranium resources and the relatively low efficiency of the once-through fuel cycle of thermal reactors, it will be necessary to introduce fast neutron breeder reactors. On the basis of current estimates of uranium reserves and likely annual availability it is argued that, even with a low growth in demand from thermal reactors, there will arise constraints on thermal reactor programmes sometime between 2000 and 2025, or even earlier (Greenhalgh 1981 p.24; Jones 1980A p.20). Fast reactors, however, can extract 50-60 times more energy from uranium than current thermal reactors and are therefore essential if nuclear fission is to make more than a transient contribution (measured in decades) to world energy needs (ibid. p. 21). Experience with experimental fast reactors has shown that the technology is feasible and safe; indeed, it is argued that it provides safety and environmental advantages over both fossil-fueled electricity generation and thermal reactors as well as reducing proliferation risks (cf. below section 8.3.1) (Greenhalgh 1981 p. 23-5).

Consequently, longer term growth prospects can be guaranteed only if fast reactor technology is developed as rapidly as possible to the

stage of commercial deployment. Moreover, even if the future is not as certain as this, it is irresponsible to gamble on nuclear power not being necessary. We need to keep all our options open and proceed along all reasonable lines of development including nuclear power. The burden of proof should lie on those who argue for delays to the development of nuclear power since delay now may mean undue and dangerous risks later on with possible restrictions on economic growth and decreased safety levels (cf. Posner 1978 p. 50-1).

An illustration of the basic reasoning behind the general economic case is provided by Maddox (1975 p. 185):

"The plain truth is that in the advanced communities of the industrialised world, as well as in developing countries, the need to increase energy consumption is irresistible. It is unthinkable that communities such as the British would consider the unemployment that a sharp decrease in energy consumption would cause as more acceptable than the small risks of reactor accidents, just as it is politically unrealistic to expect developing countries to settle for slower economic growth or reduced agricultural output for the sake of keeping nuclear power at bay. Moreover, the rapid development of nuclear power offers the most promising route to the realignment of the cost of energy on which the economic welfare of the next ten years depends. The future, in a sense, is unavoidable."

The argument for nuclear power as a means of avoiding an energy-constrained future and consequent losses of benefits of economic growth tends to be associated with optimistic views about future growth prospects, and therefore in the past few years has perhaps become less forceful as forecasts of economic growth have been down-graded. However, it is still to be found in the context of the 'high growth' scenarios produced by, for example, the Department of Energy (1982) and the CEGB (1982A). In its case for the Sizewell B reactor the CEGB argued that in the event of the high growth scenarios coming to pass up to 28 GW of new capacity would be needed by 2000 to accommodate

growth in electricity demand and pressures on fossil fuel supplies would be such that a substantial increase in nuclear capacity would be needed to provide secure energy supplies to guarantee growth prospects (ibiq. p. 55-7; Jenkin 1982 p. 37-48).

As far as opponents of nuclear power are concerned various arguments are presented in relation to this aspect of its economic implications. For example, some deny that economic growth is a benefit and that we should be concerned with achieving non-materialist values in an energy-efficient society based on sustainable and renewable sources (cf. Avebury 1978, Lovins 1977). Alternatively, it is possible to argue that economic growth can be sustained without the need for large increases in energy supplies if we pay more attention to the efficiency with which energy is used in relation to the tasks performed (cf. Leach et al. 1979). Indeed, some argue that increasing investment in the supply of more and more energy can actually hinder economic growth and therefore reduce the benefits of avoiding an energy-constrained future relative to those obtainable from measures to improve efficiency of use (cf. Commoner 1976). Particular attention will be paid here to the second position due to its apparently more widespread currency.

A central feature of the argument of opponents of nuclear power is a critique of the official practice of producing projections of future energy demand on the basis of macro-relationships with gross domestic product. For examples, Leach (1979 p. 10) argues as follows:

"Until recently, most long-range energy forecasts rested on the observation that in many countries over long periods of time primary energy consumption rose in line with GDP. From this arose the belief that the energy-GDP linkage was a rigid economic law; that energy use must grow with rising GDP and,

conversely, that a low energy future must involve fewer goods and services, fewer jobs, and belt-tightening deprivation.

Even before 1973/74 belief in this idea was beginning to crumble; the years since have all but shattered it. Numerous studies have shown that such gross relationships have no intrinsic validity beyond that of coincidence, although the accompanying mythology that energy equals wealth has been slower to die."

It is argued, then, that the development of an empirical relationship between GDP (or other measures of economic output) and energy use in the U.K., for example over the period 1950-73, is inherently unsound as a basis for projecting future energy demand. This is because such a relationship neglects the factors which are actually responsible for determining energy use. For example, much of the increase in final energy use between 1950-73 was due to increases in road traffic which is subject to saturation effects, as are electricity-consuming domestic appliances ownership of which also increased rapidly over this period (ibid). Moreover, as standards of living increase rising proportions of disposable income tend to be spent on goods with a higher ratio of price to energy consumption (eg TV, Hifi) relative to goods bought at lower levels of wealth (eg space and water heating) (Coyne 1978). Substantial amounts of energy consumed are unrelated to GDP and considerable savings could be made (for example in space heating and lighting) with no effect on GDP; conversely much of GDP creation (e.g. in the service sector) is only indirectly linked to energy use and considerable growth could be achieved with little effect on energy use (Leach op. cit.).

Consequently, traditional methods of demand forecasting are criticized as embodying assumptions which exclude many possible choices and result in a 'pre-conditioning' of policy outcomes. To the extent, then, that such forecasts are at least partially self-fulfilling,

the potential for changing energy consumption patterns is being precluded at the level of basic assumptions (Lovins 1977). The 'energy gap' or 'shortfall' which provides a major basis of the argument for nuclear power is merely ... "a figment of forecasters' imaginations" (Leach 1978 p.66).

Specific criticisms have been directed at the energy demand forecasts produced by the Department of Energy. Even if it is accepted that there is some validity in an energy/GDP relationship the economic growth assumptions or targets used by the Department of Energy have been too high reflecting an over-optimism about growth prospects (Pearce 1980A p.10; 1981 p. 24-5; Friends of the Earth 1981 para 28). On the basis of economic performance in the second half of the 1970s and perceived prospects for the mid-1980s, Pearce (op. cit.) argued that even a growth rate of 2% is optimistic as an average up to the end of the century. In their most recent energy projections the Department of Energy (1982) develop a range of scenarios based on economic growth assumptions for the period to 2000 ranging from 0.5% p.a. to 2.5% p.a.; this high figure was criticised as over-optimistic at the Sizewell Inquiry by the C.P.R.E. (Sizewell Transcripts Day 45 p. 36-9). Similar criticisms were directed at the CEGB's high growth assumption of 2.6% - 3.4% p.a. (Sizewell Transcripts Day 76 p. 45-56). The implication of over-optimism about economic growth in official forecasts is that benefits attributable to nuclear power, in the form of the quantity of GDP growth which would be sacrificed should it not be developed, are overstated. The overstatement is compounded, moreover, if the relationship between energy demand and GDP is not immutable.

As far as critics are concerned, then, the official case for nuclear power overstates the extent to which there will be an energy shortfall by the end of the century and therefore exaggerates the adverse economic consequences which would follow from a failure to supply sufficient energy. But the case against nuclear power goes further, arguing that even greater energy savings can be achieved, at no expense in terms of sacrificed GDP, by increasing the efficiency of energy conversion and use and by improved matching of energy source to the work requirements of the end use. Lovins (1979B p. 188-90) refers to studies which indicate that the application of currently cost-effective technologies could at least double Western European end-use efficiency and lead to stable or declining energy use in an expanding economy. Work by Friends of the Earth points to a possible quadrupling of the nation's fuel efficiency (FOE 1981, para 32). The influential study headed by Gerald Leach indicated that UK primary energy consumption could be stabilized at the present level while GDP trebled between now and 2025 if conservation measures and technical improvements that are currently available (or should be so by the mid-1980s) and economically attractive, were implemented in a concerted conservation programme (Leach 1979).

A variety of measures are therefore available, it is argued, to conserve energy and improve end-use efficiency without impacting adversely on economic growth prospects: indeed, some argue that investment in such measures would produce an economic stimulus (ibid; CSENE 1981). For example, a domestic insulation programme at a rate of half a million homes a year could save 3% of UK primary energy demand (CSENE 1981 p.27). Moreover, the economic return on investments in conservation measures can be much greater than investment in further supplies: some US utilities are obtaining higher returns on capital invested in

measures to avoid the need for extra generating capacity (Walker 1981). It has been estimated that combined heat and power schemes with district heating could supply one third of the low temperature heat market saving about 13% of end-use needs and 12% of primary energy demand (Marshall 1981 p. 14-15; FOE 1981 para. 35-9). A 30% improvement in motor vehicle fuel efficiency could save 40% of primary energy (Marshall op. cit.). Increased efficiency of domestic electrical appliances and lighting, and of electric motors used in industry could also produce substantial savings (Conroy 1972 p. 494). Electric and gas-fired heat pumps could take 15% of the space heating market by the end of the century (Leach 1979). All these measures are alleged to be cost-effective in comparison with investment in further supply of energy and imply a degree of government intervention which does not pose a threat to the freedom of consumer choice (ibid. p 16).

Consequently, this 'technical fix' position asserts that continued material prosperity is consistent with a stabilized or even reduced consumption of primary energy and, as a result of the more efficient use of energy, our fossil fuel resources, particularly coal, are sufficient to see us well beyond the end of the century without the need for nuclear power. As Leach (ibid. p. 19) states:

"Nuclear power in our projections thus becomes a peripheral issue and could be abandoned as an option if - for whatever reason - it became prudent to do so".

Two important features of this 'technical fix' approach, as epitomized by Leach's work (also see Chapman 1975, chap. 11), are firstly, the assumption of continued economic growth along conventional lines and, secondly, the assumption that renewable energy technologies will not make significant contributions until well into the next century.



However, some opponents of nuclear power adopt more 'radical' positions by questioning these assumptions.

As indicated above, some critics reject the notion that economic growth represents a benefit which can be accounted to justify social and technological developments. They argue that the use of GDP as a measure of social welfare represents bankrupt, narrow 'materialist' thinking and that the continuous pursuit of increasing consumption of material goods within a growth-oriented society cannot solve fundamental social problems. An example of this position is provided by Avebury (1978 p. 19).

"Is the so-called civilised world really so bankrupt of ideas that the only major political goal is perpetually increasing consumption of material goods and 'thus of energy? We consume more already than we need to keep ourselves properly nourished there is enough accommodation for all; we have enough fuel to keep warm; and there are the means of adequate mobility. The reasons why some people do not have enough of these goods still are not inadequacies of supply, but waste, misallocation, and inefficiencies of distribution. And experience shows that continued growth does not solve the question of poverty, on a world scale or within our country".

Rather, it is argued that there is a desperate need to consciously re-evaluate our social goals and priorities instead of implicitly accepting the 'status quo', and to see energy as a cost of achieving these consciously-desired values so that the emphasis is placed on achieving these with maximum efficiency in primary energy use, and so that the development of nuclear power does not occur, as it were, by default, merely to postpone what must eventually be a necessary social exercise in one form or another (Lovins 1977 p.12-13; Commoner 1976 p. 257).

Many opponents of nuclear power are critical of the pessimistic assumptions which, allegedly are applied to the assessment of the supply potential of renewable sources of energy no less than those applied in respect of the potential for conservation (Patterson 1977 p. 42, 89; 1978 p. 129; Leach 1978 p. 55, 66; Lovins 1977 p. 15-16, 22). It is argued that the low energy scenarios based on renewable technologies and conservation, which are in fact being developed and demonstrated throughout the world, are attacked and dismissed by supporters of nuclear power as hypothetical, speculative and presenting severe technical problems. On the contrary, high energy scenarios based on nuclear power, which are seen as representing very challenging options in terms of complex technology and massive investment programmes, attract favourable and optimistic evaluations in spite of a record of disappointed expectations as epitomised by the British AGR programme (cf Burn 1978, Henderson 1977). This asymmetry is seen as prevailing energy forecasting and policy making reflecting the power of institutions with a vested interest in the expansion of fuel supplies; while the interests behind fossil fuel and nuclear energy supply are institutionalized, those behind conservation and renewable sources of supply are not. It is argued that the asymmetry is reflected, for example, in the economic evaluation of renewable in relation to nuclear options, renewable technologies being subjected to rigorous economic evaluation and dismissed as 'uneconomic' in relation to conventional rates of return on capital invested, while over the past 25 years the nuclear power programme has been developed on the basis of a huge public subvention not subjected to conventional economic criteria. Therefore, it is alleged that the potential economic contribution of renewable energy sources is greater than supporters of nuclear power are prepared to admit and,

given a 'balanced and fair' assessment programme such sources could provide a significant proportion of our energy needs. (Lovins 1977)

The question of the relative costs of renewable and nuclear energy will be considered more fully in the next section; more relevant here are arguments to the effect that the potential of renewables is such as to render invalid the image of the energy-constrained world prevalent in pro-nuclear thinking. For example, Lovins (1979) argues that in combination with measures to improve end-use efficiency, renewable sources of energy can make a significant contribution to energy supplies in both developed and developing countries, could achieve 'impressive deployment rates', and indeed have advantages in terms of technical risk and 'resilience' (ibid p.194-7). In relation to countries of the Economic Commission for Europe (ECE) he argues that . . .

" . . an extremely wide range of practical, technically sophisticated, and economically interesting devices in each end-use category is in commercial production, currently entering such production, or technically mature enough to enter such production a year or two after a modicum of final product engineering. It appears that such existing technologies for solar space and process heat, pyrolysis and fermentation of biomass residues, wind collection, microhydroelectrics and low-temperature solar heat engines - suffice to meet all or a very large fraction of the long-term energy needs of even the least favourably situated ECE countries (Denmark and the UK). In short, deployment could begin immediately without waiting for any technological break throughs (many of which, however, appear imminent). (ibid p. 194-5)

Studies for the UK by the National Centre for Alternative Technology (NCAT 1978) and by Friends of the Earth (FOE 1981)

also argue for significant contributions from renewable energy in conjunction with concerted conservation efforts; solar, wind and biomass technologies are seen as being particularly appropriate in the UK context. Friends of the Earth (1981) argue that solar collectors could

supply 'virtually all' our water heating and most space heating requirements. As regards wind energy, the CEGB has estimated a potential contribution from offshore sites of up to 230 Twh which exceeds the current level of annual sales of electricity in the UK and which should increase with technical developments in the near future (Wright 1982A).

A variety of positions are therefore adopted by critics of nuclear power in relation to the issue of avoiding an energy-constrained future and the resulting adverse consequences for economic growth. Such positions are, in broad terms, characterized by varying emphases on the desirability of economic growth, the potential for energy conservation through demand management and measures to improve end-use efficiencies, and the potential for energy from renewable sources. As indicated earlier, the position which appears to have gained the most currency (perhaps because it is the one taken most seriously by supporters of nuclear power) is that characterised by Gerald Leach's work, accepting continued economic growth, emphasizing conservation and efficiency and assuming that the potential of renewables will not be realized until well into the next century. From this perspective there are two further arguments which are commonly put forward to suggest that the development of nuclear power does not promote the objective of securing future economic growth.

Firstly, it has been argued by some critics, notably Lovins (1975, 1977, 1979B) and Commoner (1976), that the extreme capital intensity of nuclear power may actually hinder economic growth prospects.

Lovins, for example, suggests that substantial nuclear power programmes would place such demands on the mechanisms of capital formation and

allocation that non-energy sectors might be starved of capital, especially in times of public expenditure restraints, thus jeopardizing the economic growth which is assumed to generate the demand for nuclear electricity, and exacerbating unemployment problems (1975 p. 42; 1979B p. 184). Further, he argues that the high capital intensity and long lead times of large nuclear plant, by tying up large amounts of capital non-productively during the long construction period, exacerbate inflation and destabilize utility cash flows (ibid; 1977 p. 9-10). Consequently, nuclear power programmes might well aggravate the already serious economic predicament in the western economies rather than guaranteeing future growth as argued by its proponents (see also Patterson 1978 p.132; Matthews 1980 p. 26-7).

This line of reasoning is further elaborated by Commoner (1976 chaps. 8-9) who maintains that nuclear power development actually exists in a parasitic relationship with economic growth and not the symbiotic relationship hypothesized by its proponents in which the investment funds for nuclear power are generated by the growth in GDP which it stimulates. He argues, then, that in a capitalist economy the logic of the profit motive results in the continual substitution of capital and energy for labour. But such a process of substitution tends to result in the declining productivity of capital and energy, and the increasing productivity of the remaining labour, resulting in further pressures to substitute labour (ibid p. 223-4). As the productivity of capital declines private sector generation of investment funds becomes increasingly difficult and public sector investment grows as the state intervenes to subsidize the economy's capital needs, and to attempt to promote economic growth in order, firstly, to alleviate the unemployment problem which results from labour substitution and, secondly, to stimulate private capital

formation. However, it is argued that economic growth derives primarily from increases in labour productivity which result from capital investment and the implication is that nuclear power, having little impact upon labour productivity and, indeed, diverting investment from sectors which could have such an impact, may actually hinder the process of economic growth and contribute to the severity of the state's public expenditure crisis (ibid chap. 9). This crisis is also likely to be exacerbated by the increases in unemployment that derive from diversion of investment to (unnecessary) capital-intensive energy production from more labour intensive sectors of the economy.

A similar line of reasoning is presented in a Western European context by the Agenor Cooperative (Agenor 1979) which argues that the massive capital requirements of nuclear power constitute a real threat to economic growth and to employment prospects particularly in countries like Britain which have a relatively high ratio of energy consumption to GDP (ibid p. 18-21). Employment implications have also been singled out for special attention. For example, studies in Germany have argued that nuclear programmes create fewer jobs at higher cost than alternative programmes of energy conservation and renewables (ibid p. 7-9). In the UK context Elliot (1979) has presented similar arguments although his work has been criticised by Pearce (1979B) from the 'conventional' perspective which sees nuclear power as providing the best means of guaranteeing future growth and, therefore, future employment prospects.

There is a further argument which is relevant to the economic growth issue. It is sometimes argued by critics of nuclear power that if the cause of the future economic well-being is served by maintaining a capability for flexible response and 'keeping all our options open'

(as implied by official UK policy objectives) then the development of nuclear power does not best promote that cause. Specifically, it is suggested that pushing ahead with the development of nuclear power at the present time requires very large amounts of public money for investment and research and development at a time when such funds are in short supply thus effectively starving alternatives, such as conservation and renewables, of funds (cf Flowers 1976 p. 195-7).

Secondly, the early development of nuclear power would produce increased dependence on a centralized electricity distribution system which reduces the scope for later change to alternatives not consistent with such a system (Patterson 1977). Moreover, as energy demand continues to grow to higher and higher levels it becomes increasingly difficult to sustain and the options available for such sustenance become increasingly limited (cf Lecomber 1979 p. 179-80).

Finally, pursuit of the nuclear path strengthens the power and influence of the institutions behind nuclear power and electricity supply on the energy policy making process (Patterson 1977, 1978). It is argued, then, that all these factors would maintain and even strengthen the existing asymmetries which pervade policy making and would therefore detract from the cause of keeping future policy options open with possible adverse implications for economic stability. On the contrary, the cause of future flexibility is seen as best served by placing maximum effort on eliminating waste, increasing efficiency of use and conservation, and developing the most promising renewable energy sources in order to buy time to undertake a thorough assessment of the need for, and the risks involved in, nuclear power development (Lovins 1975 p. 52-4, Flowers 1976 p. 194-5).

There are, therefore, fundamental divergencies of opinion between supporters and opponents of nuclear power in relation to the issue of the extent to which nuclear energy is necessary in order to avoid an energy-constrained future and the resulting adverse consequences for economic growth. The principal focus of controversy in this context concerns the potential for energy conservation, with nuclear critics tending to emphasize the technical potential while supporters emphasize macroeconomic problems and behavioural constraints. This controversy will be examined rather more closely in Chapter 9. As regards alternative sources of supply arguments about potential contributions must proceed beyond the technical level to the question of the relative costs of energy from different sources. Specifically, in any assessment of the economic benefits to be derived from nuclear power the question of its contribution to the avoidance of future energy shortages has only partial relevance. Perhaps of greater importance particularly in the present 'low growth' context is the question of the cost of nuclear energy compared with alternatives and therefore of the extent to which investment in nuclear power represents the best use of available resources by providing electricity at the lowest possible resource cost.



### 7.3 The Cost of Nuclear Electricity Generation

This issue has in recent years come to the fore in the official case for nuclear power development in the UK and is the basis for the argument that nuclear power is economically justified at the present time simply on a fuel substitution basis, given current fossil fuel prices, irrespective of future trends in the demand for electricity (Secretary of State for Energy 1981 p.4; Department of Energy 1982). The position has been stated in broad terms as follows:

"Nuclear power stations have much higher initial capital costs than coal-fired stations, but because of their low fuel costs and operating characteristics are particularly suited to continuous baseload operation. They therefore displace existing coal or oil-fired power stations in the 'merit order' . . . . and lead to substantial savings in fuel costs. The CEBG calculate that over the life of a new nuclear station its total cost, including both capital and running costs, should be outweighed by the fuel savings in other stations which it will make possible".

(Secretary of State for Energy op. cit. para 25).

As a result of such fuel cost savings, therefore, fewer resources are required for the generation of a given amount of electricity and more resources are available for other investment with consequent GDP gains.

Indeed, this aspect of the economic case for nuclear power is at the forefront of the CEBGs case for the Sizewell B nuclear power station (CEGB 1982A). Although it is argued that the construction of the reactor is justified on the grounds of lifetime operational cost savings, the contribution to the diversification of power station fuelling, and the provision of capacity to replace time-expired plant and meet any increase in electricity demand, it is the first of these grounds which is considered paramount (ibid. p. ii-iii):

"The economic appraisal of Sizewell 'B' shows it to be a good investment in its own right and a superior investment to a coal-fired station. The CEGB's studies also indicate that within a wide range of futures the provision of further nuclear generation would be more economic than coal and would serve to minimise the cost of electricity . . . .

The overall cost of generating electricity by a nuclear station is less than by a fossil fuel station because the operating costs, including those of the nuclear fuel cycle, are so much less. The economic advantage achieved by savings in the use of costly fossil fuels is not significantly altered by variations in the electricity demand since savings against fossil-fired plant still remain". (ibid. para. 13-14).

Until relatively recently comparisons of the generation costs of electricity from different sources were presented in terms of 'works costs' which include costs of fuel, operation, repairs and maintenance. In 1976 the CEGB incorporated residual fuel reprocessing and disposal costs into ex-works costs; in 1979 the first comparisons were published which included capital charges and provision for decommissioning; and in the following year interest during construction and expenditure on research and training were incorporated. On the latter inclusive basis the CEGB has, since 1980, published comparative generation costs for nuclear, coal-fired and oil-fired power stations (cf. CEGB 1980 ) and recently the Board has again expanded the scope of its comparisons to examine lifetime station costs and to accommodate the opportunity costs of invested capital (CEGB 1983). The more recent figures and the assumptions upon which their calculation is based, are set out in Annex 2 Tables A1-A3.

Tables A1 and A2 illustrate the sensitivity of calculations of generation costs to changes in the basis of costing. On the monetary interest cost basis (employing current cost depreciation) there is little difference between the 1981/82 generation cost of Magnox and modern coal stations. However, the effect of discounting on the basis of opportunity cost is to significantly increase capital charges

and this disproportionately affects the older more capital intensive Magnox stations. This affect is less marked over longer periods of analysis (ie lifetime-to-date and total lifetime) but nevertheless the advantages of modern coal stations over the Magnox stations is maintained if the 5% discount rate is applied. This places a question mark against the economic benefit accruing from the investment in Magnox stations although, given their existence, the fuel and operating cost advantages merit their operation on baseload.

However, the Board's figures for the Hinkley Point AGR indicate that such newer nuclear power stations are currently producing cheaper electricity even employing 5% opportunity cost. (Table A2). On the basis of assumed future trends in costs the Board calculates that Hinkley Point should produce a lifetime economic benefit although the cost of lifetime-to-date generation is significantly higher than that of Drax First Half due to the transition period to maximum output. As regards power stations currently under construction (or recently completed) (see Table A3) anticipated lifetime generation costs of the nuclear (AGR) stations are lower than those of Drax Second Half with the exception of Dungeness B, the higher cost of which is due to the considerable delays in the construction period.

It is evident from these figures that investment in the past and up to the present time in nuclear capacity has not resulted in an economic benefit in the form of cheaper electricity than could have been obtained from coal-fired stations; however, the CEGB remains optimistic that over their full lifetimes the AGR stations currently operating and under construction will produce such an economic benefit (except for Dungeness B). The Board's economic case for nuclear power therefore refers primarily to their anticipation of the future costs and

and performance of electricity generating plant and in such a context the performance of such plant to date is seen as providing little guidance.

The running cost advantage of nuclear power stations indicated in the CEGB's calculations results in their being operated to the limit of their availability, providing base-load electricity. However, the costs estimated for stations already in operation are historic costs and therefore do not constitute an appropriate basis for decisions on future investment in new capacity (Hunt 1978 p. 339; Department of Energy 1981 p. 12-13). The case for continued investment in new nuclear capacity, such as the proposed PWR at Sizewell, rests upon calculations of the marginal effect of new stations on the costs of the generating system as a whole over the lifetime of such stations. Briefly, the investment appraisal method used by the CEGB assesses the effect of the addition of 1 KW of new capacity on the cash flows of the Board from the start of construction to final decommissioning including, firstly, the direct and indirect costs of station construction (including interest during construction), fuel and operating costs over the life of the station and an annual charge for the cost of decommissioning and, secondly, the net system fuel savings which result from the displacement of older, less efficient plant with higher fuel costs. The cash flows of expenditure and savings are discounted to the date of commissioning at the required rate of return laid down by the government for Nationalised Industries (currently 5%) and averaged over station lifetime. The difference between generation costs and marginal savings gives a 'Net Effective Cost' (NEC) expressed in terms of £/KW p.a., to allow for different lifetime load factors. The objective for investment in new capacity, then, is to choose plant with the lowest NEC (ie the smallest positive or largest negative value)

and introduce that plant up to the point at which the savings of Net Avoidable Costs (NAC) due to retirement of old plant just cease to offset the NEC of the new plant. At this point optimal plant mix is achieved (CEGB 1981A p. 59; 1981B p. 559-60; Baker 1982 p. 22-3; Jenkin 1982).

The Net Effective Cost calculations produced by the CEGB for the proposed Sizewell B PWR nuclear power station in comparison with AGR and coal-fired capacity are reproduced in Annex 2, Tables A4 and A5. These figures indicate that over the wide range of possible future trends in economic and energy demand growth the Sizewell B PWR has a lower Net Effective Cost than the alternatives and further that AGR stations have a lower NEC than coal stations. The advantage of the PWR is maintained in all the 'nuclear backgrounds' (ie independently of assumptions about the build-up of nuclear stations in the plant mix) but is most pronounced in the lower nuclear backgrounds where fossil fuel savings would be greatest. Moreover in all scenarios and against all nuclear backgrounds the CEGB calculates a negative NEC for the PWR which means that it is economic to construct such nuclear plant on energy cost savings grounds alone to replace existing fossil fired plant which has a positive annual Net Avoidable Cost (Jenkin 1982 p. 48-62).

Consequently, as far as the CEGB is concerned, in all reasonable futures and for parameter assumptions which are considered to be 'best estimates', the PWR maintains its economic advantage and electricity generation costs would be minimised by substantial commissioning of such reactors. As Table A5 indicates, the NEC advantage of the Sizewell station arises because the higher capital cost is very much outweighed by the extra fuel cost of coal-fired stations particularly in a low nuclear background where the higher demand for coal would mean that marginal supplies would be higher cost imports (Hughes 1982 p. 70-82; CEGB 1982A p. 58-60).

These calculations of future costs and system savings rest upon certain judgements and assumptions about parameter values. Of particular importance are assumptions relating to capital costs and fossil fuel prices. The CEGB assumes that the Sizewell PWR could be constructed at a cost of £1172 mill. over a period of 7½ years and would achieve a settled-down average annual availability of 64%. As regards future coal prices, it is assumed that the CEGB will be faced with substantial increases in real terms over the next fifty years or so of the order of about 2 - 3% p.a. Recognising the uncertainty surrounding such key assumptions (and responding to certain criticisms by the Monopolies and Mergers Commission) the CEGB tests the sensitivity of its calculations to changes in these and other assumptions. However, it is argued that the economic advantage to nuclear plant is robust against lower fossil fuel price increases, construction delays, capital cost escalation, nuclear fuel cycle cost escalation and decreases in power rating of magnitudes considered to be extremely unlikely (CEGB 1982A p. 60-1; Jenkin 1982 p. 67-75).

The CEGB's arguments in relation to the costs of nuclear-generated electricity have been subjected to severe criticism over the years by opponents of nuclear power. For example, a study was recently undertaken by a group of critics in the guise of the Committee for the Study of the Economics of Nuclear Energy (CSENE) and their argument was presented in CSENE (1981). Colin Sweet, a prominent member of CSENE, has separately published his views in Sweet (1978, 1982) as has Professor Jim Jeffery (1980, 1982) who acted as consultant to the committee. To a large extent the criticisms which were directed at the CEGB's figures for comparative generation costs related to the statement in the Annual Report (cf CEGB 1980) in which such costs were expressed

in terms of historic prices without allowances for the effect of inflation. It was argued that revenues from electricity sales have in the past been generated only to cover actual expenditure undertaken and not to cover the true replacement of assets at current prices. In effect customers have enjoyed artificially cheap electricity resulting in a misallocation of resources and placing an excessive burden on future customers for the replacement of depreciated assets i.e. retired power stations (CSENE 1981 p. 20; Jeffery 1980 p. 344; Sweet 1982 p. 33-5, 56-7). The 'hidden subsidy' resulting from historic cost accounting has, it was argued, attached particularly to nuclear power stations because of their high capital costs and because fuel for a nuclear station is paid for in the more distant past than that for fossil-fired stations (CSENE op. cit). Therefore, more electricity has been sold and more nuclear power stations built than should have been the case had prices reflected the real cost of resources used.

As we have seen, the CEGB now uses current cost accounting procedures in order to value its assets in terms of current replacement cost, and the most recent analysis by the CEGB of its generation costs incorporates many of the accounting modifications suggested by critics. The effect on nuclear costs in particular of taking account of the opportunity cost of capital was indicated above (see p.304); both capital and fuel costs of nuclear stations are affected but only capital costs for coal-fired stations since coal is purchased during the year in which it is used (CSENE op. cit. p. 21). The figures reproduced in Annex 2 Section A show that the use of a real interest rate of 5% applied to costs related to current costs results in an increase in the 1981/82 generation cost of Magnox stations of 64% compared with 11% for coal-fired stations. For Hinkley Point B and Drax First Half the equivalent figures are 38% and 13%. Using such an opportunity cost of capital the Board now recognises that the

Magnox stations will not produce an economic benefit over their lifetimes.

However, there are certain other arguments put forward by critics of nuclear power which are not met by the CEGB's present accounting procedures. For example, when costs are presented in terms of pence per KWh of output those stations producing the greatest lifetime output are at an obvious advantage. The calculation of generation costs is heavily dependent upon load factor - the higher the load factor the greater the number of units of electricity generated to which the 'overhead' costs of a power station can be apportioned (Sweet 1978 p. 108-9; Jeffery 1980 p. 345). The relatively high capital costs of nuclear stations means that they must be operated at as near to maximum capacity as possible (ie at the top of the merit order), producing baseload electricity, if the target of low unit costs is to be achieved. However, this means that the coal-fired stations, with which cost comparisons are made, are displaced down the merit order, used more for peak load and consequently operate at less than the capacity that would have been the case had such stations been built instead of nuclear stations. As Jeffery (1982 p. 77) argues:

"If coal-fired stations had been built instead of Magnox nuclear stations they would have replaced them on baseload, i.e. on full availability. The comparison must therefore be on the basis of LF ... (load factor) ... equal to availability. In the absence of nuclear stations these new coal-fired stations would have been at the top of the merit order. There would therefore be no question of running these out of that order".

Therefore, it is argued that in cost comparisons the generation costs of coal-fired stations should be reduced to what they would have been had they been operating at the same capacity as nuclear stations. The CEGB rejects this argument in relation to comparisons of existing plant but accepts its importance in future appraisals (cf. CEGB 1983 Appendix D).



Several critics have argued that there are many costs associated with nuclear electricity generation which are not, but should be, included in the CEGB's accounting costs; the bearing of such costs elsewhere is seen to result in an effective subsidy to nuclear power. For example, the CEGB's own research and development (R & D) costs are now included but the exceptionally large R & D spending by the UK Atomic Energy Authority (AEA) is not covered by royalties even though it is widely accepted in principle that they should (Sweet 1982 p. 56). It has been argued that the scale of public funding of the AEA has been heavily influenced by the military implications of nuclear power development (particularly in the case of the plutonium-producing Magnox reactors) and therefore insulated from commercial considerations (Patterson 1977 p. 19-20; 1978 p. 127). Further, the value of plutonium in spent Magnox fuel was credited against Magnox generating costs although this practice was never justified (Sweet 1982 p. 36-7). Various other distortions due to the exclusion of 'internal' costs have been criticized, for example, extra costs of providing an electricity distribution system suitable for nuclear power, the full cost of government-financed fuel-cycle and storage facilities, the full costs of decommissioning nuclear reactors and of finally disposing of waste products, and the cost of publicity material for nuclear power produced by the AEA, Electricity Council and CEGB which would have to be covered in prices were these private companies (cf. Sweet 1982; Coyne 1978; Patterson 1977; Bunyard 1980).

The implications of such additional factors have not been precisely costed but it is argued that they could be expected to further increase the true cost advantage which accrues to coal-generated electricity in relation to that produced by nuclear stations. Consequently, the building of such stations by the CEGB is seen as having resulted in

dearer electricity than would have been the case had coal-fired stations been built instead and, therefore, in a misuse of resources and an adverse impact upon economic growth. This position was adopted by the Select Committee on Energy in their First Report on the nuclear power programme:

"Enormous past nuclear investments have had exceptionally low productivity; great resources have been used with little direct return and a serious net loss"

(Select Committee on Energy 1981 para. 172).

Moving on to the question of investment appraisal in relation to future generating capacity the CEGB has once again come in for heavy criticism. The above-mentioned Select Committee Report contained the following criticism(*ibid.* para 71):

"....(I)n view of the inevitable uncertainties surrounding many of the Board's key assumptions, the obscurity of presentation of much of the relevant information, and the Board's less than satisfactory attitude to cost comparisons, we remain unconvinced that the CEGB and the Government have satisfactorily made out the economic and industrial case for a programme of the size referred to by the Secretary of State in his statement to the House in December 1979".

The Monopolies and Mergers Commission (MMC) report on the efficiency and costs of the CEGB published in May 1981 was somewhat less equivocal:

"..(W)e consider that there are serious weaknesses in its investment appraisal. In particular a large programme of investment in nuclear power stations, which would greatly increase the capital employed for a given level of output, is proposed on the basis of investment appraisals which are seriously defective and liable to mislead. We conclude that the Board's course of conduct in this regard operates against the public interest".

(Monopolies and Mergers Commission 1981 p. 292).

The MMC was particularly concerned about the way in which the Board derived assumptions used in investment appraisal both in respect of fuel availability and price and construction times and costs of new plant. It argued that the Board should conduct wider sensitivity and risk analysis and, indeed, the Board has responded by improving its appraisal procedures as exemplified in its case for the Sizewell B PWR power station as considered above (see p.306). Therefore, the Board's approach to investment appraisal is not now a focus for criticism (cf. Conroy 1983 p. 61): rather the attention now tends to be placed upon the parameter assumptions which are input to the appraisal process.

In general terms, it is argued by opponents of nuclear power that the assumptions used by the CEGB as 'central estimates' incorporate a degree of optimism which reflects a prior commitment to a significant programme of nuclear power construction (Jeffery 1982 p. 85; Sweet 1982 p. 11-12). As indicated earlier, the results of investment appraisal are highly sensitive to, in particular, assumptions in respect of future cost of fuel (especially coal) and future capital costs of nuclear plant and critics argue that the biases operate via both of these sets of assumptions.

As regard the price of coal, then, the CEGB's net effective cost (NEC) calculations for new plant, as epitomised by the case for Sizewell B discussed above, employ a central assumption of an increase of around 2% p.a. from 1984-85. This has been criticised as an over-estimate, based on over-optimistic assumptions about future economic growth and not taking account of the effects of conservation and structural change in the economies of OECD and newly industrialized countries (Conroy 1983 p. 74). The Department of Energy's assumptions about future fossil fuel prices for their 1982 Energy Projections also came in for sub-

stantial criticism at the Sizewell B Inquiry for giving too much weight to higher rates of increase (cf. Sizewell Transcripts Day 41 p. 19-27, 49-50). Indeed, the National Coal Board, in their evidence, argued that future coal prices were likely to be "... around the bottom of the range of ..... assumptions and estimates submitted to the Inquiry by the Department of Energy and by the CEGB". (ibid. p. 25).

On the other hand the CEGB is criticised for making optimistic assumptions concerning the future cost of nuclear fuel. Jeffery (1982 p. 82-8), for example, has argued that a complete asymmetry pervades the CEGB's reasoning since, whereas coal costs have been relatively stable in the recent past and seem 'virtually guaranteed' to be so in the near future, the cost of nuclear fuel has increased considerably since 1973/74 and shows no signs of slowing down in the future.

Nuclear fuel costs have been increasing due to the effects of inadequate provision for inflation, a series of accidents and difficulties at the Sellafield reprocessing plant and increasing uranium prices (Jeffery 1980 p. 345-6; Sweet 1978 p. 114). However, although Magnox fuel has been subject to cost escalation primarily due to the reprocessing element, the CEGB expects that the cost of reprocessing oxide fuel (from AGRs and PWRs) will prove to be lower; this expectation is reflected in the assumptions incorporated in the NEC calculations for Sizewell 'B' (cf. Wright 1982B). Critics argue that the CEGB is guilty of 'wishful thinking' and that the real replacement fuel costs for both AGR and PWR stations (after fully allowing for inflation) is likely to be substantially higher than is assumed (Jeffery 1982 p. 88-90; Conroy 1982 p. 492).

Assumptions about the future capital costs of nuclear plant are also of crucial importance to the calculation of economic benefits: indeed,

such costs are the most important factor in determining total nuclear generation costs. In its case for Sizewell B the CEBG used estimates of capital cost for PWR plant of £1056/KWSO (March 1982 prices) and an assumed construction period of 7½ years which allows for an extra 18 months over the target period of 6 years to accommodate design changes and uncertainty (CEBG 1982A p. 21-30). However, considerable criticism has been directed at these assumptions, again to the effect that they represent wishful thinking and bias in favour of nuclear power (Jeffery, 1982 p. 96-7; CSENE 1981 p. 30; FOE 1981 p. 523; Sweet 1982 p. 42-9; Conroy 1982 p. 491-2, 1983 p. 65-72).

More specifically, these critics argue that the capital cost of future nuclear plant is likely to be considerably higher than the CEBG's estimates due to construction time overruns (which boost interest charges and other indirect costs) and due to various other elements of construction cost escalation. Much has been made of the CEBG's poor construction record, especially with the AGR programme. Hinkley Point B, commissioned in 1978-79, took 12 years to complete (twice the planned construction period), Hartlepool 15 years and Heysham A 13 years; Dungeness B is due to complete commissioning in 1984 18 years after start on site. The combined time overrun of these reactors is 142%. These delays, combined with cost escalation due to design changes have had a considerable impact on capital costs. Sweet (1982 p. 43) cites an increase from an original estimate of £430 million to an outturn of about £1800 million in the official figures, but the CEBG have presented an estimate of £2500 million (including interest during construction) to which should be added the cost of generating electricity in other power stations to replace that which was not available as a result of delays to AGR stations; the Board estimate the latter cost to be £1200 million at January 1980 (CEBG 1981B paras 5.1 - 5.2).

Burn (1981) has updated Henderson's (1977) figures for the cost of the AGR programme (including the SSEB's Hunterston B reactor) presenting an estimate of between £8,700 and £11,100 million. In the light of such estimates it is argued that the AGR programme will never provide a return on the capital invested and that there can be little confidence in the ability of the CEGB to build future reactors to time and cost (FOE 1981, p. 523; Conroy 1982 p. 491-2; Jeffery 1982 p. 97).

As we have seen, the CEGB does not accept this argument insisting that, with the exception of Dungeness B, the AGR programme will result in net system savings; over its whole lifetime Hinkley Point B is expected to have lower generation costs than coal plant and the Hartlepool and Heysham reactors are calculated to have NECs which are lower than the cost of retaining the least efficient plant on the system (ie Net Avoidable Cost). Moreover, the Board argues that the factors responsible for the delays and cost overruns in the AGR programme have been identified and will not apply in the future to either AGR or PWR construction; progress at Heysham II is held up as vindication for this position.

However, the critics remain sceptical of this argument. For example, at the Sizewell B Inquiry it was suggested by witnesses for the Council for the Protection of Rural England (CPRE) that the CEGB have underestimated potential problems in respect of design changes for safety reasons and construction delays with consequent distortion to the calculation of economic benefits (Conroy 1982 p. 492; 1983 p. 65-72). Komanoff's studies of American experience of PWR construction were used; he had shown that greater construction delays were experienced with PWRs than with coal-fired stations

and average capital cost escalations between 1971-78 were estimated at 13.5% p.a. in real terms for PWR stations compared with 7.7% p.a. for coal-fired stations. Further, Komanoff calculated nuclear capital costs in 1978 to be 50% greater than coal on average and anticipated that this would increase to 73% by 1988, producing a 25% advantage to coal-generated electricity in the USA (cf. Taylor 1981 p. 31-2; Sweet 1982 p. 15). At the Sizewell Inquiry, Komanoff argued that the CEGB had not used the most recent data available on actual capital costs and construction periods for Westinghouse plant, which indicated significant escalations, and that problems originating from safety-related design differences and industrial and construction conditions could result in a capital cost increase of 50% over the CEGB's estimate (Komanoff 1983 p. 34-8). Conroy (1983 p. 68) criticises the CEGB's approach to this question in the following terms:

"The CEGB's capital cost estimate is to my mind an engineering-based one conceived from a narrow technological perspective. When broader social, political and environmental processes are taken into account it is clear that the processes which have driven up capital costs in the past will continue to do so in the future". (ibid).

There is a further assumption which is important in the estimation of the NEC of future nuclear power stations and this concerns the performance of generating plant over its lifetime. In its calculations the CEGB assumes a settled-down average annual availability on design rating for AGRs of 65% and for the Sizewell B PWR of 64%. The latter figure was again criticised as over-optimistic by Conroy and Komanoff who argued that US performance of Westinghouse units of over IGW indicates an average settled-down availability

of 57-61% and suggested that a figure of 58% should be assumed by the CEGB and that even this may be over-optimistic over reactor lifetime given the possibility of problems due to ageing and saltwater cooling (Komanoff 1983 p. 36-7; Conroy 1983 p. 73). More generally, for PWR stations in the 'Western World' the cumulative load factor, weighted to allow for the range of reactor sizes, stood at 54% in 1981 (Howles 1982). Further, experience to date indicates inferior performance of larger plant in the case of almost all reactor systems (ibid p. 16). Burn (1978) shows how the performance of UK Magnox stations has deteriorated as their size increased and Surrey and Thomas (1980) indicate that much of the trouble is caused by higher coolant temperatures in larger units and by steam generation components.

Opponents of nuclear power therefore argue that the combined effect of introducing more realistic assumptions, in respect of future fuel and capital costs, construction time and reactor performance, into the economic appraisal procedure would be to render the NEC of nuclear plant greater than that of coal-fired plant and, indeed, than the system net available cost. Thus, the CPRE argued at the Sizewell B Inquiry, that their figures ....

"...suggest that Sizewell B is likely to result in a serious net loss of public money, and that it would be at best a marginal investment". (Conroy 1983 p. 76).

However, the CEGB on the contrary argue that their case is robust against adverse sensitivity tests assuming, for example, increases in capital costs of 15%, in nuclear fuel cycle costs of 20% and in construction time of one year and decreases in average annual availability of 7%, in rating of 5% and in the growth of fossil fuel prices by 25% (Jenkin 1982 p. 67-75).



Finally on the issue of investment appraisal, opponents of nuclear power have argued that the case presented for nuclear power is open to criticism to the extent that all the possible alternative investment options are not fully evaluated. For example, at the Sizewell Inquiry the CEGB was criticised for failing to properly analyse the potential for conversion of oil-fired capacity to coal and perhaps more significantly the potential of investment in electricity conservation measures to produce system savings (Conroy 1983 p. 78).

The CEGB argued that conservation cannot be considered as an alternative to the construction of further nuclear capacity since, whatever the degree of conservation which might be achieved, the CEGB must aim to generate the resulting requirement for electricity at minimum cost. It is argued, therefore, that this aim is met by the construction of new nuclear plant to produce baseload electricity irrespective of the effect of conservation on marginal generation by more costly plant (Jenkin 1982 p. 57-8). However, this argument was criticised by Barrett (1983), on behalf of the CPRE, whose analysis suggested that conservation to reduce peak demand, and therefore fuel burn at the times when the highest cost plant is operating, would displace the highest cost generation and produce system savings which should be compared with those of new plant. It was argued that by 2000 conservation could reduce restricted peak demand by 3.8 GW producing a fuel saving of 60 mtce. and resulting in system generation costs lower than those that would result from the construction of Sizewell B; consequently, investment in conservation measures should precede investment in new capacity.

#### 7.4 Conclusion

The main thrust of the critics' economic case against nuclear power is therefore directed at the proponents' arguments broadly accepting the 'ground rules' and frameworks within which they are formulated. The intention is to demonstrate that nuclear power is unnecessary to the maintenance of future economic well-being and, further, that it is likely to be detrimental to such well-being by using resources in an uneconomic way. In answer, then, to the proponents' view that there are substantial economic benefits which more than offset any social costs and risks, the critics deny the existence of such benefits and, indeed, argue that there are substantial economic disbenefits which must be added to the social costs and risks. However, the case is taken further by some critics who emphasize the importance of 'external costs' of nuclear power which should be fully compensated and therefore reflected in the price of nuclear-generated electricity. This issue relates particularly to the safety and environmental implications of nuclear power which will be considered in the next chapter; however, the significance of the issue for nuclear economics will be briefly considered here.

Obviously, not all social costs and benefits can be monetarized but some allowances are made for financial compensation of externalities and some elements in the cost of nuclear power relate to social costs. However, it has been argued that the resulting cost elements fall well below full compensation and that, as a result, nuclear electricity is receiving a substantial effective subsidy which distorts resource allocation (CSENE 1981 p. 33-6; Shrader-Frechette 1980 p. 108-26). For example, despite the serious potential consequences of accidents at nuclear plant the financial liability of the operator

is limited to £5 million and underwritten by the Government for a further £50 million causing a subsidization of nuclear electricity from general taxation (CSENE op. cit. p. 36; Shrader-Frechette op. cit. p. 113-4). Radiation emission controls at nuclear plant are governed by economic considerations (in relation to what are perceived as 'acceptable risks') rather than a concern to achieve total containment; Shrader-Frechette (op. cit. p. 115-8) argues that all loss of life is not therefore being compensated again an effective subsidy to nuclear electricity. A further source of distortion of the cost of nuclear electricity in relation to that of coal-generated electricity is cited by Jeffery (1982, note 7, p. 78). He argues that the development of nuclear power on the basis of a massive public subsidy (R & D funds and distorted cost calculations) contributed towards the run-down of the coal industry in this country; if true commercial consideration had been in operation coal-fired plant would have been built instead and we would now have a more efficient coal industry, producing cheaper coal under safer conditions. The implication is that these extra costs in the coal industry should really be attributed to nuclear power. Similar arguments are sometimes made in respect of the effect of distorted resource allocation on alternative technologies (especially in the fields of conservation and increased efficiency of use) which would otherwise have developed to promote economic growth and, possibly, export earnings. For example, Sweet (1982 p. 27) argues as follows:

"The cost of pursuing the nuclear option emerges not just as the cost of building and operating nuclear power stations but also as the cost of opportunities foregone. These costs are rarely calculated but they are in the long run the most important of all".

However, whilst it is argued that such external costs of nuclear power are of considerable importance there is a limit on the extent to which they can be quantified and allowed for in economic calculations. This is particularly so in the case of safety and environmental implications and some critics of nuclear power reject any attempt to impose an economic calculus, in the form of cost-benefit analysis, on what they see as primarily an ethical and political issue (cf. Lovins 1975 p. 49). Therefore, although they have economic aspects, it is appropriate to consider separately the implications of nuclear power programmes which are collectively categorized as 'social costs'.

## Chapter 8: The Social Costs of Nuclear Power

### 8.1 Introduction

In this chapter an attempt will be made to indicate the main aspects of the debate over the social or 'external' costs of nuclear power. They will be considered in two categories: firstly, safety and environmental implications and, secondly, social and political implications. As regards the former the major areas of controversy which are relevant here concern the question of routine radiation emissions from nuclear plant, the issue of the risk of a major accident producing substantial releases of radiation, and the problem of the management and disposal of radioactive wastes. These issues will be considered in turn in the next section followed by a brief discussion of other environmental implications such as the problems of atmospheric pollution and land-take. The main areas of controversy which are of interest in relation to social and political implications concern the linkages between the development of civil nuclear power programmes and the proliferation of nuclear weapons, and the possible impact of such programmes on traditional rights and liberties of individual citizens.

## 8.2 The Safety and Environmental Implications of Nuclear Power

### 8.2.1 Routine Radiation Emissions from Nuclear Power Plant

The operation of the nuclear fuel cycle necessarily involves some release of radioactive substances which results in exposure of the workers in the industry and the general public to small amounts of radiation. The harmful effects are of two kinds: somatic harm, the damage done to an individual (e.g. cancer) and genetic harm, the damage done to descendants through exposure to radiation by predecessors (Bonnell 1982 p. 2-7; Pearce et al 1979 p. 141).

Radiation is commonly measured in this country in terms of the 'rem' ('Roentgen Equivalent Man') which gives a 'dose equivalent' and is a function of two variables, the absorbed dose ('rad') and the quality or nature of the radiation (e.g. electrons, fission neutrons or alpha particles) (ibid.; Wade 1981 p. 290-1).

The effect of low radiation doses on human beings (indeed, on all living things) is an issue of some controversy, since relatively little evidence is available on low-dose situations and the dose-response relationship for such situations is obtained largely through backwards extrapolation from high dose experiences (Pearce 1979A p. 37). The 'conventional wisdom', and the analysis largely subscribed to by supporters of nuclear power, is the 'linear hypothesis' which suggests that cancer incidence is a linear function of radiation dose and that the function passes through the origin. It is held that this hypothesis is 'cautious' in that it overestimates the risks from low doses of radiation (Pearce et al 1979 p. 144-4; CEEGB 1982A p. 71). Wade (1981 p. 292-3) argues that at such low doses, such as may be found near a nuclear reactor, no significant adverse effects whatever have been observed in humans nor indeed, in plants and animals.

The linear dose-response hypothesis provides the basis for radiation safety standards for occupational and public exposure as recommended by the International Commission for Radiological Protection (ICRP) and agreed in many countries as the appropriate standards for regulations (Bickerstaffe and Pearce 1980 p. 317; Matthews 1982 p. 9-11; Wade 1981 p. 293). The annual dose limits recommended by the ICRP are more stringent for public exposure than for occupational exposure by a factor of 10, the whole body limits being, respectively, 500m rem and 5 rem (dose equivalent) with a lifetime average for the public of 100m rem (see Annex 3, Table A1; Matthews 1982 p. 17-18; Wade 1981 p. 294). Supporters of nuclear power generally accept the ICRP recommendations as authoritative, as providing a firm foundation for the standards actually set by the National Radiological Protection Board (NRPB) and for legislation controlling the release of radiation (e.g. Radioactive Substances Act 1948 and 1960, Factories Act 1961, Nuclear Installations Act 1965 and 1969, Health and Safety at Work Act 1974) (ibid. p. 295-6; CEEGB 1982A p. 65-6, 71-3).

The radiation doses to workers and the general public deriving from the routine operation of nuclear plant are relatively low compared with ICRP dose limits and proponents of nuclear power emphasise that they are strictly controlled by the well-developed safety practices of the industry (ibid. Hill 1976, 1981B). According to official figures the maximum exposures resulting from the UK nuclear industry are typically less than 1 per cent of the ICRP standards (see Annex 3, Table A2). Moreover, it is widely argued that the risks from low level radiation exposure due to nuclear electricity generation are low in comparison with the risks from other sources, either those naturally occurring or those already generally accepted. For example,

natural background radiation contributes an annual average dosage to the public of about 186m rem, or approximately three quarters of the total dosage; by comparison the annual dosage attributable to the nuclear industry is officially given as about 0.3m rem or approximately 0.15% of background level (see Annex 3, Table A3; cf. Hill 1981B p. 4; CEGB 1982A p. 68-70).

Comparisons with other 'human-made' sources of risk are also commonly made to demonstrate the safety of nuclear power. Of the total radiation exposure to the public from 'human-made' sources about 85% is derived from medical irradiation, according to NRPB data; by comparison the contribution from nuclear electricity generation is given as 0.5% (see Annex 3 Table A3). Comparisons are often made with the risk of smoking cigarettes; Hill (1981B p. 4) argues that the current level of radiation exposure from the nuclear power programme presents a risk of cancer which is less than that attributable to smoking two cigarettes in a lifetime. These radiation risks are also compared with the carcinogenic and mutagenic effects of many other agents, especially chemicals, which are seen as presenting far greater hazards (cf. Hoyle 1977 Chap. 6). Moreover, much has been made of the work, for example, of Inhaber who argued that of all the means of producing energy (including renewable sources) nuclear electricity generation is the safest (Bickerstaffe and Pearce 1980 p. 317; Jones 1980B p. 149-51). As regards workers in the nuclear power industry NRPB data, based on regular routine monitoring, indicates an average annual radiation dose of 0.5 rem (one-tenth of the ICRP recommended maximum) which compares favourably with other industry, representing about 16% of total occupational whole-body exposure (see Annex 3, Table A3; Wade 1981 p. 297). Relative to all occupational hazards the risks to radiation workers are calculated to be relatively small involving, for example, an average life shortening of 7 days compared



to 20 days for all manufacturing industry and 150 days for coal mining (ibid. p. 296-7).

It is evident, then, that in arguments designed to demonstrate the low levels of risk involved in the routine operation of nuclear power plant, comparisons with other risks and hazards play an important role. The importance of comparisons has been argued by Häfele (1974). He suggests that the only means of determining what constitutes an 'acceptable' level of risk is by 'embedding' the estimated risk and standards into the 'normal conditions of life' - that is by comparing them with the risks occurring in nature or as part of our accepted 'normal' social existence (ibid. p. 308-11). The position presented by Häfele represents a basis for the justification of the risks of nuclear power which is seen as 'natural' by its supporters.

A final element in the argument of proponents of nuclear power in relation to low-level radiation is a conviction that public concern about the effect of radiation is misplaced. For example, Hill (1981B p. 5) argues that because the human senses do not react to radiation people are deprived of the ability to apply common sense to judgements about the safety of nuclear power and, consequently, the public's fears are unnecessarily magnified. It is argued that the effects of radiation on humans is, in fact, well understood and easily measurable to levels well below those of significance to health (Wade 1981 p. 296). Radiation exposure is tightly controlled by a substantial body of legislation and by several expert advisory and regulatory bodies for example, the Nuclear Installations Inspectorate, the NRPB and various government departments (ibid; Hill 1981B p. 6-7). The public can, it is argued, be assured that nuclear power does not present a significant radiation hazard and is safer than other forms of energy

and other occupations (ibid; Greenhalgh 1980 p. 143-70). Wade (1981 p. 298) summarises as follows:

"The radiation dose to the public is demonstrably quite trivial, and those working in the nuclear industry have one of the safest occupations. The residual risk is easily justified by the associated benefits."

The critics of nuclear power, however, argue that the routine radiation discharges from the operation of nuclear plant present a much greater hazard to both the general public and to workers in the nuclear industry than that accepted by its proponents. Their criticisms have three main thrusts, directed, firstly, at the linear dose-response hypothesis, secondly, at the data on radiation dosage used to demonstrate the comparative safety of the nuclear industry and, thirdly, at the justification of radiation risks by comparison with other types of risk.

Criticism of the linear dose-response hypothesis upon which ICRP standards are based draws on experimental evidence which, it is alleged, indicates that the hypothesis underestimates, possibly by a considerable degree, the risks from low radiation doses. For example, a large amount of evidence was presented at the Windscale Inquiry, in particular by Dr Alice Stewart and Professor Edward Radford, in support of this argument (Pearce et al 1979 Ch. 7). Stewart's early work on cancer in children, found a significant effect due to low-level X-ray doses to pregnant mothers (Bunyard 1981 p. 116-7). More recently, her work with Mancuso and Kneale on radiation risks to workers at the Hanford reactor plant in the USA suggested that low levels of radiation were responsible for an excess number of cancers up to 20 times more than the linear hypothesis would predict as a maximum feasible number (ibid p. 118-9; Pearce et al 1979 p. 144-5). Radford also cited recent work to suggest that low levels of radiation were more damaging than had hitherto been

thought and that ICRP standards were therefore greatly in excess of the desirable maximum (ibid. p. 144-6). Lindop (1980) also cites various studies which cast doubt upon the linear hypothesis. For example, data on the incidence of lung cancer at Hiroshima has indicated maximum effectiveness of the irradiation at lower doses; linear extrapolation from high dose data therefore underestimates the low-dose risk (ibid p. 108-9). A similar picture emerges from studies of breast cancer (ibid. p. 111).

Consequently, opponents of nuclear power consider the ICRP recommendations to be far too lenient, perhaps by as much as a factor of ten or twenty (Bunyard 1981 p. 106). Recent modifications to these recommendations involving the use of weighting factors for individual organs have resulted in large increases in the dose limits for some organs, for example, bone marrow and lung. These have been criticised as flying in the face of evidence on low dose effects (ibid. p. 115; Lindop 1980 p. 111; Pearce et al 1979 p. 146). Moreover, such modifications are seen as totally inconsistent with the recent reduction, by the US Environmental Protection Agency, of the whole body dose limit for the general public from the ICRP's 500 mrem to 25 mrem per annum.

Finally, some critics argue that the validity of radiation standards is jeopardized by the essentially 'committed' nature of the organisations responsible for them. The general problem here is seen as the institutional framework within which standards are established and monitored. It is argued that the impartiality and independence of bodies concerned with recommending such standards (e.g. ICRP, NRPB) is in doubt because their membership, and the research upon which standards and recommendations are based, are not totally independent from the specialist confines of government or the nuclear industry

(cf Bugler 1979 p. 34-6). At the Windscale Inquiry, Radford criticised the ICRP from this point of view (Pearce et al 1979 p. 145-6). Further, some question the ability of current regulatory processes and the institutional arrangements upon which they are based to adequately monitor and enforce satisfactory standards and maintain proper control (Bugler op. cit.).

The second major line of criticism for opponents of nuclear power relates to the level of the radiation dose to workers and the general public deriving from the nuclear industry. In effect, it is argued that the official statistics do not present the true magnitude of the problem of radiation exposure. The nuclear industry is relatively young and its effect on people and the environment is still quite small compared with other well-established industries (Patterson 1978 p. 128 Bunyard 1981 p. 111). The contribution of nuclear energy to the worlds' energy consumption is currently less than one per cent and the safety record to date must, it is argued, be set in this context (Lindop 1980 p. 113-4). Moreover, the consequences of low dose radiation are nearly all long term so current records of casualties of radiation exposure can be expected to understate the problem (Bunyard 1981 p. 111-2). However, cancers amongst radiation workers are beginning to show up; BNFL have made out-of-court settlements in relation to the deaths from cancer of two Windscale workers and NRPB data is said to indicate an increase in cancer in incidence amongst such workers (ibid. p. 120). Further, there is concern at the alleged neglect of potential long-term genetic harm from nuclear power programmes; Bunyard (ibid. p. 124-5) cites work by Dobzhansky which suggests a possible increase in the genetic mutation rate which would be a cause of concern.

As nuclear programmes expand such long-term effects will become increasingly problematical and it is therefore considered illegitimate to justify such expansion on the basis of figures which do not properly reflect the long-term implications. However, the official statistics are also criticised for concealing the existing true dosage of many workers. Lindop (1980 p. 114), for example, argues that present occupational exposures in the fuel cycle are a matter for concern indicating that a significant proportion of reprocessing plant workers in the UK are receiving between 3.5 and 5 rem external radiation per year excluding internal exposures. Bunyard (1981 p. 114) alleges that the nuclear industry manages to keep average doses within limits only by employing casual workers to perform tasks involving high exposure who are then discarded and replaced when they have accumulated their maximum radiation allowances. The impression given by the official figures, that an installation is safe within accepted standards for workers on a year-round basis, may therefore be misleading. A further area of hazard which Bunyard argues is neglected in the UK data concerns the risks to uranium miners, who suffer the highest casualty rate from radiation-induced cancers, and the risk to the general public from radioactive wastes from mining and ore milling operations (ibid p. 120-2). A true picture of the hazards of nuclear power should, it is argued, include the risk from all stages of the fuel cycle even if all the stages are not present in any one country (ibid).

The first two strands of the critics' case can therefore be brought together. On the one hand, it is argued that the harmful effects of low level radiation are underestimated in the linear dose-response hypothesis and that exposure standards based upon this hypothesis are therefore too lenient. On the other hand, it is alleged that the figures used by supporters of nuclear power to demonstrate the safety

of the industry understate the true extent of low level radiation exposure attributable to the nuclear fuel cycle. The resulting conclusion is that nuclear power causes far more harm to workers and the general public by virtue of its routine low-level radiation emissions than its proponents would have us believe and that this will become a serious problem (if it is not already) as nuclear programmes expand. It is therefore considered illegitimate to justify such future expansion on the basis of this safety argument either in terms of absolute levels or in terms of comparisons with other sources of risk. However, the question of comparisons has another aspect besides the relative accuracy of the comparative data and it is this aspect which constitutes the third major strand of criticism for opponents of nuclear power.

Basically, the issue is a moral and philosophical one and the essence of the critics' position is that it is illegitimate to justify the risks from nuclear power with reference to other risks particularly when the comparison is made either with unavoidable risks or with risks which people voluntarily choose to take. As Pearce et al (1979 p. 143) argue it is widely felt that an involuntary risk (one 'imposed' upon a person) is less acceptable than one which is freely entered into (e.g. smoking). To the extent, then, that the risks to the public and workers from nuclear power are not voluntarily taken, the comparison between such risks and those, for example, of smoking n cigarettes a day, are, it is argued, liable to mislead people into perceiving the risks as equally acceptable. Moreover, the process of 'embedding' the risks from nuclear power in the 'normal conditions of life' involves the implicit imposition of 'naturalistic ethics' according to Shrader-Frechette (1980). Briefly, she argues that the establishment of the acceptability of the risks of nuclear power with reference to other

risks which currently exist in our society is based upon the assumption that the latter risks are in some way morally justified (ibid. p. 26-36). In a sense, then, nuclear risks are being justified 'by the back door' since the existence of certain risks in society (e.g. from other industrial processes, from food and other environmental sources) does not mean that they are considered 'acceptable' or necessary and there is no a priori reason why people should accept the continued accumulation of risks just because they do not exceed existing ones.

To opponents of nuclear power, then, routine radiation emissions from the nuclear fuel cycle do constitute a non-trivial indeed significant problem. In relation to official plans for nuclear expansion and, in particular, the introduction of breeder reactors, Lindop (1980 p. 114) concludes that "...the radiation hazard to the population may prove to be the factor limiting the utilisation of nuclear energy."

Prior (1980A p. 10) argues that as epidemiological evidence accumulates radiation standards will have to be made more stringent and this will cause nuclear costs to rise and public concern about nuclear facilities to increase; both these trends will further militate against the expansion of nuclear programmes.

### 8.2.2. The Risk of Major Accidents

In essence, supporters of nuclear power argue that the safety of nuclear plant can be guaranteed to very high levels on the basis of engineering measures and institutional safeguards. The probability of a major release of radiation is very small and can be reduced even further with continued experience of reactor operation. The safety record of the nuclear industry compares most favourably with that of other high technology industries and the risks associated with nuclear power are

comparable to those widely accepted at the present time. While not accident-proof, therefore, nuclear power is nevertheless safe to an acceptable degree.

The argument can be outlined in rather more detail. The degree of dilution of nuclear fuel in a reactor core is such that it cannot explode like a bomb. However, certain types of failure, affecting the cooling and moderation systems, could cause the core to overheat (and, at worst, melt down) threatening the integrity of the containment structure (due to steam explosions and pressure increases) and resulting in release of fission product gases, radioactive coolant and other radioactive substances into the environment. As Wade (1981 p. 297) puts it, "...a reactor could accidentally overheat and it might then leak some radioactive materials."

However, the nuclear industry is extremely safety-conscious and has a very good safety record. A variety of precautions are taken "...to ensure that the risks of any significant radioactive release are reduced to vanishingly small levels." (Jones 1981 p. 149). Firstly, exceptionally high standards of design, engineering and operation are maintained within the industry (Hill 1981B p. 5; Wade 1981 p. 297). Secondly, multiple safety provisions are incorporated providing 'defence in depth' to prevent failures and to contain any adverse effects should they occur (ibid.). Thirdly, all these features of design, construction and operation are subject to independent scrutiny and supervision by (in the UK) the Nuclear Installations Inspectorate (NII) throughout the life of a reactor from initial design to final decommissioning (ibid; CEGB 1982A p. 63-5; Jones 1981B p. 149; Hill 1981B p. 6-7).



It is argued, then, that through these measures and procedures it is possible to ensure exceptionally high levels of safety but not to eliminate altogether a small 'residual risk' of a major accident. Even though this residual risk may be small it is nevertheless seen as important that continual efforts are made to improve procedures and standards. In this context Hill (*ibid.* p. 8) refers to improvements in techniques for detecting cracks in metal components; the discovery of cracks in Magnox plant which, he argues, have been there from the beginning, is seen not as an indication that such stations are 'unsafe' but as part of the process of technical progress which will ensure continued and improved safety in the future.

As regards the estimation of the small levels of 'residual risk', it is not possible to base calculations on past events since the actuarial record of operating reactors is not long enough (Bickerstaffe and Pearce 1980 p. 317). Neither, for obvious reasons, is it possible to calculate such risks on the basis of 'trial and error', the traditional engineering approach (Häfele 1974 p. 313). Rather, it is regarded as necessary to estimate the probability of an accident in the future within a formal, quantitative framework which derives the probability of a final outcome from an analysis of component events in accident sequences, which themselves are assigned probabilities in a 'fault-tree' framework (*ibid.* p. 319-20; CEGB 1982A Ch. 17; Bickerstaffe and Pearce 1980 p. 317). Such formal probabilistic analysis is generally seen as providing a good 'scientific' basis to the study of the safety of nuclear power, accepting that safety can never be a matter of proof (Häfele *op. cit.* p. 320-21; Greenhalgh 1981 p. 24). Two basic principles therefore emerge from such an approach. Firstly, although absolute safety is not obtainable the framework provides good grounds for confidence that very low probabilities of failure can be

achieved by exploiting favourable characteristics in the system and containing or reorganising the less favourable ones (ibid.). Secondly, it is misleading to focus on the consequences of the worst possible accident since this diverts attention away from the central issue of probabilities and efforts to reduce them (ibid.; Hill 1981B.p. 3-4).

The most comprehensive analysis to date of the risk of major accidents in nuclear reactors was undertaken by Professor Rasmussen of MIT for the US Nuclear Regulatory Commission. This study employed the techniques of probability analysis and is widely quoted by supporters of nuclear power in support of arguments in respect of safety. Rasmussen's calculations are commonly taken as probabilities which are comparable with observed probabilities of other types of accident; Figure B1 in Annex 3 reproduces the often-used comparisons (cf. Hill 1978 p. 14-15; 1981B p. 3-4). The target curve for nuclear reactors indicates a probability of one in a million reactor years of an accident producing as many as seventy fatalities (cf. Patterson 1976 p. 202); that is, a chance of one in 10,000 years for a programme of 100 reactors. Such estimated risk levels are small compared with frequencies of accidents due to other 'human-made' causes.

The Rasmussen study related to American light water reactors but its results are seen as vindicated by subsequent studies for British and German reactors (Wade 1981 p. 298). Moreover, the accident at Three Mile Island in 1979, the most serious <sup>to</sup> date involving a commercial power reactor, is also seen as consistent with the Rasmussen estimates. The accident which, according to the Kemeny Commission probably caused no bodily harm, occurred after a few hundred reactor-years of operation; its a priori probability has been estimated at about one in 400 reactor-years of operation on the basis of the Rasmussen study

(ibid.; Weinberg 1980 p. 35). The Three Mile Island incident, then, is not regarded as having revealed any fundamental weakness in the PWR concept or its basic engineering; rather, the Kemeny Commission has placed the emphasis more on 'people-related problems' (CEGB 1981A p. 61).

More recently, the CEGB has undertaken a comprehensive analysis of the safety of the Sizewell B PWR using state-of-the-art probabilistic techniques (CEGB 1982A Volume 2). The basic approach involves applying certain design principles firstly to attempt to ensure that faults do not occur and secondly to provide the means of limiting and mitigating their consequences should they indeed occur (ibid. p. 98-101). Techniques of probabilistic safety analysis were employed to assess the adequacy of the design proposals and the CEGB's analyses indicated that safety standards would be satisfied when the designed safeguard systems operated at their minimum assumed performance. Radiation doses to the public due to faults leading to release of radioactivity were estimated in most cases to be negligible in relation to the NRPB's 'Emergency Reference Level' Standard of 10 rem whole body dose above which countermeasures (such as evacuation) are judged to be justified. Faults within the design basis (e.g. Loss of Coolant Accidents) were estimated to have probabilities within the design target of  $10^{-6}$  per reactor year for all accidents leading to uncontrolled releases. Finally, as regards the 'remotely possible' accidents beyond the design basis, probabilistic risk assessment methodology was applied and indicated that degraded core accidents involving failure of containment had probabilities of occurrence of no greater than  $10^{-7}$  per year, producing a risk of death of  $10^{-8}$  for any individual close to the site and a total number of early deaths of a few tens to a few hundreds. These analyses were seen as providing justification for the safeguard systems and barriers designed into the Sizewell PWR and confidence that design targets could be achieved (ibid. Chapters 14-21).

It is argued, therefore, that there are high standards of reactor safety and that this situation reflects the substantial amount of care and money that has gone into design and construction (Hill 1978 p. 14). As indicated above supporters of nuclear power commonly place some considerable emphasis on demonstrating that the risks involved are 'acceptable' and this involves comparisons with other risks which, it is argued, are widely accepted in everyday life (Matthews 1982 p. 37-40). One approach to defining 'acceptable risk' is that illustrated by Lord Rothschild who has argued that the risk of being killed in a car accident in Great Britain (about one in 7,500 in 1974) can be used to define an upper limit of acceptability (Bickerstaffe and Pearce 1980 p. 319). Another approach has recently been adopted by the US Nuclear Regulatory Commission who have proposed that nuclear reactors should be considered acceptable if, in the event of an accident, they caused no more than two extra deaths for every 1000 deaths from other causes amongst the population within a 50 mile radius (New Scientist, 18/2/82 p. 421).

The comparisons indicated in Annex 3 Figure B1 are often used in support of the argument that the 'residual risk' from nuclear accidents is very small and 'acceptable' in view of the countervailing economic benefits. The Rasmussen probability estimates are compared with, for example, the observed probabilities of people being killed by an aircraft crashing on them (100 times more likely than death due to nuclear power), by being knocked down by a road vehicle, or by choking on food (Wade 1981 p. 298). Also comparisons are made with risks from competing sources of energy; reference has already been made to arguments based on Inhaber's analysis of the comparative risks of alternative energy systems which concluded that nuclear power is safer

than both conventional non-renewable and renewable sources (Jones 1981B p. 149-52). Finally, the Rasmussen probability estimates are sometimes compared with the frequency and magnitude of natural hazards and conclusions drawn that the risk from nuclear power is, for example, comparable with that from meteors and around 10,000 times less than that from earthquakes and other natural disasters (Hill 1978 p. 15).

Notwithstanding the general belief in the safety of nuclear power amongst its proponents there does exist some variation in the degree of confidence in existing safety levels. For example, Tombs (1978 p. 5) argues that "...the safety of nuclear plants is no longer a matter for major concern..." and that continued efforts to improve safety levels will cause an unnecessary escalation in costs; "... fixation on the safety of the nuclear process ... (is resulting in)... a growing and continuing misuse of restricted resources to the detriment of the welfare of mankind." (ibid). However, Alvin Weinberg adopts a more cautious view. He argues that given Rasmussen's estimate of a probability for an accident releasing 'sizeable amounts of radioactivity' of one in 20,000 per reactor year, then in a world with 5,000 reactors one might expect such an accident every four years and this he considers to be unacceptable (Weinberg 1978 p. 78; 1980 p. 35). In such a nuclear future, he suggests, the a priori accident probability must be reduced by a factor of up to 100 (ibid). To achieve this, technical improvements will make a contribution but certain institutional changes are also required and he suggests the creation of large, confined, permanent 'nuclear centres' in remote areas controlled by a 'cadre' of "...highly expert, professional people invested with institutional longevity." (op. cit. 1978 p. 79; cf. 1980 p. 35).

Misgivings about the likelihood and consequences of a major accident involving nuclear fuel cycle facilities figure prominently in the arguments of many opponents of the development of nuclear power. Broadly speaking, three major elements can be detected in such arguments: firstly, it is suggested that the safety record of the nuclear industry to date does not inspire the degree of confidence that proponents commonly exhibit; the second element comprises a critique of the probabilistic analysis of risk upon which the safety case primarily rests; and thirdly, opponents are critical of the practice of justifying the alleged risk levels by comparisons with other risks which presently characterise our social existence. I shall briefly review these arguments in turn.

Firstly, then, critics of nuclear power argue that the accident record of the nuclear industry is not as good as it is often made out to be. Bunyard (1981 ch. 8), for example, argues that many accidents at nuclear facilities involving small radiation releases, have not been disclosed to the public and have only recently come to light; he cites evidence of 194 accidents and incidents at the Windscale reprocessing plant between 1950 and 1977 and refers to criticism of BNFL's 'inadequate safety consciousness' by the Nuclear Installations Inspectorate in relation to leakages of radioactive wastes at Windscale (ibid. p. 156-60). Lovins (1975 p. 26-7) refers to a US Atomic Energy Commission report on the safety of light water reactors (LWRs) which found that many incidents involved malfunctions or deficiencies in safety related equipment and had potentially significant consequences; the report concluded that the actual incident record was not consistent with the estimated levels of risk which emerged from probabilistic analyses.

Such probabilistic analyses of risks from nuclear power also come in for heavy criticism. Such criticisms cover a broad range of theoretical and practical issues and only a brief review will be attempted here. Reference was made earlier to Häfele's (1974) argument to the effect that the absence of an experiential basis for the estimation of the risks of nuclear power necessitated the use of formal simulation frameworks. But critics argue that the use of such frameworks cannot bridge the gap which necessarily exists between expectations and experience in cases where such experience cannot be obtained because of the nature of the technology (Lovins 1975 p. 12-14, 25-7). The safety of nuclear reactors cannot be proven by experiment so it is necessary to rely on analogies with other highly engineered systems whose potential risks are orders of magnitude less and qualitatively different in kind, and on mathematical simulations in a context of considerable uncertainty (ibid). But the resulting probability calculations are estimates which are contingent upon certain assumptions; they are effectively targets whose achievement depends upon the assumptions being satisfied. They cannot be taken as 'facts' of reactor performance although their precise quantitative nature does tend to elicit this interpretation (Taylor 1980 p. 77-8). As Lovins (1975 p. 25) argues (quoting Kendall):

"...(m)athematical models cannot be used reliably to span large gaps in engineering knowledge, owing to the very great uncertainties that accumulate in long and unverified chains of inference."

The question of the safety of nuclear power is therefore, as far as the critics are concerned (and, indeed, as Alvin Weinberg has argued), more one of opinion, judgement and instinct, human capacities which are easily influenced by aspiration and expectation, than one of scientific fact (ibid. p. 14). Calculations of low probabilities for

major accidents are merely indications of what might be achieved if the hypotheses and assumptions embodied in the analysis could be verified. However, the hypotheses and assumptions commonly employed in risk analyses have also been subjected to criticism. For example, it is argued that the assumption of randomness and independence of accident events is not always valid due to the importance of concurrent or 'common-mode' failures in which events are interdependent or causally related (ibid. p. 27; Bickerstaffe and Pearce 1980 p. 317). Moreover, it is suggested that many engineering and operational assumptions are highly optimistic neglecting the 'realities' of variable production standards and quality control and, in particular, of human fallibility; for example it is argued that whatever the safeguards operator error will always be a significant and unpredictable variable (ibid.; Bunyard 1981 p. 167; Prior 1980A p. 9; Lovins 1975 p. 12-14, 27; Flowers 1976 p. 78).

Consequently, the problem of ensuring the safety of nuclear power is not seen as merely, and exclusively, a technical and engineering problem. Rather, the critics tend to emphasise what Lovins calls the 'paratechnical' domain in which the obstacles to the solution of the safety problem lie "... in the interaction of people with technology, in the social and psychological processes on which the implementation of technical solutions must depend." (ibid. p. 14). The position has been developed by Ravetz (1974) who questions the extent to which our civilisation is sufficiently advanced in institutional, moral and social terms to be able to ensure the high standards of social engineering which are required for the safe operation of nuclear power facilities. In particular, he argues that problems of commitment by managers and operatives, of the impossibility of strictly enforcing rules and standards, and of 'degeneration' in the routine tasks upon which safety engineering necessarily depends - such problems, which relate to



the institutional social and moral 'quality' of our civilisation, threaten the attainment of adequate systems of safety-control for nuclear power and, indeed, for other technologies which have a similar destructive potential (ibid. p. 323-5).

Various other criticisms have been directed at the framework of probabilistic risk analysis. For example, it is argued that the emphasis on low probability targets diverts attention from the likely consequences of major accidents and therefore submerges subjective factors which are important to the assessment of the social valuation of risk (Taylor 1980 p. 79; Bickerstaffe and Pearce 1980 p. 319). Also within a quantitative framework consequences tend to be expressed in terms of fatalities, neglecting other factors such as distress and anxiety (ibid. p. 317). In general terms, it is argued that such a framework provides and reflects the 'fallacy of misplaced concreteness'; simulated numbers take on the appearance of facts disguising gaps in our knowledge and devaluing unquantifiable phenomena (ibid. p. 320; Lovins 1975 p. 25). Moreover, the problem is exacerbated because some proponents of nuclear power present the simulated target probabilities as the actual chances of a reactor accident concealing the fact that they are contingent upon a set of assumptions whose achievement in practice is considered to be highly problematical (Taylor 1980 p. 77-8).

On the basis of this position, opponents of nuclear power have been highly critical of the Rasmussen Reactor Safety Study which has been widely used by supporters of nuclear power to support their arguments. The methodological and statistical basis of the whole exercise has been questioned particularly in respect of assumptions of randomness and independence of many variables for which knowledge is lacking (Welch 1980 p. 29; Lovins 1975 p. 62). Critics argue that the study

greatly underestimates the probability of failure in reactor systems due to various errors and invalid assumptions. For example, Lovins (op. cit. p. 57-9) argues that the study fails to identify all the ways in which complex systems can and do fail (e.g. multiple failure of safety devices); cannot take into account currently unknown design errors; assumes (wrongly) that common-mode failures are insignificant; interprets optimistically the sparse data available on component and human failure; neglects deliberate acts of non-compliance with procedures and regulations (e.g. sabotage); and assumes no serious inadvertent errors in construction and operation.

Moreover, the study has been criticised for seriously underestimating the long-term health effects of the radioactive releases of a major nuclear accident (ibid. p. 59-60; Welch 1980 p. 19-25). It is argued that the study takes into account only prompt 'acute' deaths while playing down or ignoring long term cancers and genetic effects thus providing a distorted picture of consequences. Further, unrealistic assumptions are used in respect of the long term biological effects of radiation (e.g. dose response curves), the effectiveness and speed of evacuation procedures, and weather and population variables (ibid. p. 25-7; Lovins 1975 p. 60-1). Welch concludes that the study does not provide a reliable estimate of the risks involved in nuclear power, cannot be considered as impartial, has been widely misused to promote political goals, and has served to mislead the public about the risks and probable consequences of a nuclear reactor accident (op. cit. p. 19, 31-3).

As regards the Three Mile Island incident, critics of nuclear power insist that its implications are far more serious than the proponents allow. For example, Bunyard (1981 p. 167-73) argues that the reactor core came very close to melting down and that a catastrophic accident

was avoided more by luck than by any intrinsic safety procedures. Moreover, the economic implications are seen as very serious not only due to the clean-up costs but also due to the loss of a relatively new power station (ibid. p. 170). The Friends of the Earth (1981 p. 528-9) have argued that the Kemeny Commission conclusions on the incident cannot be seen as giving the PWR design a 'clean bill of health' since it was not remitted to study generic safety problems. Indeed, it is argued that several such problems remain associated with the high power density of the PWR's core, the use of water as a coolant, and doubts about the reactor shut-down systems (ibid.; Conroy 1982 p. 493).

Other problem areas which are of concern to critics include the increasing difficulty of maintenance and repair as reactors get older and more radioactive, and the risk of accident at fuel reprocessing facilities (Bunyard 1980 p. 126-7; 1981 p. 161-3, 177-8). Overall, the opponents of nuclear power argue that the risks are considerably greater than the estimates derived from probabilistic analysis indicate, that such estimates are widely used in a misleading way and that the framework of quantitative risk analysis, although a valuable scientific tool, is open to considerable abuse. Finally, the critics take issue with the practice of attempting to justify particular levels of risk by comparing them with other risks which are considered to be widely accepted as part of everyday life. Welch (1980 p. 34) puts the argument in the following terms:

"It may be that a major nuclear accident would have consequences which crudely are quantitatively comparable to the health effects of widespread heavy smoking in the same population. This would not diminish their significance, however. Nor would it justify deliberately deceiving the public in order to minimise its perception of the magnitude of the risk. Rather, it would emphasise

the need to face more squarely the risks of both smoking and nuclear power. Relative risk assessment is always important. But it is very important who assesses the relative importance of the different risks, and whether the risks experienced are accepted openly, knowingly, and voluntarily."

The definition of acceptable risks carries an implication of valuation of benefits which are considered to justify taking particular risks. The cost-benefit approach may be more or less explicit; it is favoured by economists but many object to the monetary valuation of human life (Pearce 1980B). For example, the US Nuclear Regulatory Commission's recent proposals for levels of acceptable risk from nuclear power plants have caused controversy because of their implication that the possibility of 13,000 deaths during the lifetime of 150 nuclear stations in the USA is acceptable and that spending on safety measures, to prevent one rem of exposure per person, of more than \$1000 is not justified by the benefits (New Scientist 18/2/82 p. 421). Shrader-Frechette (1980) argues that the definition of a particular level of risk as 'acceptable' with reference to an associated level of economic benefits betrays a utilitarian ethic representing a particular moral and ethical stance (neglecting, for example, considerations of equity, need and future generations) which is contestable (ibid. p. 147-9). Moreover, the attempt to justify risk with reference to low probability calculations and to other risks defined as 'normal' or 'natural' represents, she argues, an example of the 'naturalistic fallacy' (ibid. p. 135-51). This involves the unjustifiable derivation of ethical conclusions (about what is 'good' and 'ought to be') from empirical observations (of what 'is'). In the argument that the risks from nuclear power are acceptable the reference to economic benefits, to the low probability estimates and to other risks present in our society begs the question of why they are normally good or acceptable (ibid.). Value judgements are therefore

being imposed implicitly in a sense 'by the back door', resulting in the elevation of conventional values as 'common sense' and the acceptance of the status quo as morally desirable (ibid. p. 151).

This practice of risk justification, combined with the great complexity of probabilistic analysis of risk, has implications for the extent and nature of public involvement in the policy-making process which are a cause for concern to many opponents of nuclear power. However, this issue will be taken up in the next chapter. It is necessary here to go on to consider a further important safety and environmental issue - the problem of the management of waste products from the nuclear fuel cycle.

### 8.2.3 The Management of Radioactive Wastes.

The radioactivity associated with the nuclear fuel cycle is almost entirely created within the reactors, mostly in the fuel but also from neutron activation of other materials in the reactor (Passant 1982 p. 2). Small quantities of fission products escape to appear in the wastes within nuclear power stations but most radioactive wastes occur in the form of a highly active liquid concentrate produced as a result of recovering uranium and plutonium from irradiated fuel at reprocessing facilities. Such high level waste constitutes the primary focus for concern in the waste management problem (cf. Patterson 1976 p. 108; Marshall 1981 p. 262).

Radioactive waste management policy the the UK has been based upon guidelines set out in 1959 in The Control of Radioactive Wastes White Paper and embodied in The Radioactive Substances Act 1960. These guidelines related to an objective to ensure that doses to the public should not exceed ICRP limits and, for the whole population, an average of 1 rem per person in 30 years (Passant op. cit. p. 4). In 1976 The Royal Commission on Environmental Pollution questioned existing procedures for waste management, pointed to the absence of clearly formulated policy and concluded that insufficient attention had been given to long-term problems of waste management (Flowers 1976, Ch. 8). The Government responded in 1977 with the Nuclear Power and the Environment White Paper which gave to the Secretary of State for the Environment responsibility for policy on the management of civil nuclear wastes and, more specifically, the task of ensuring that waste management problems were dealt with before any large nuclear programme is undertaken (Passant op. cit. p. 5). In addition an independent standing committee (the Radioactive Waste Management Advisory Committee -

RWMAC) was set up to advise on the development and implementation of policy and an Expert Group established to review existing legislation, which reported in 1979. (ibid. p. 6). The recommendations of this Group were substantially accepted by the Government and were embodied in the Radioactive Waste Management White Paper of 1982 which based the objectives of waste management in the UK on the ICRP system of dose limitation as interpreted by the NRPB. (ibid. p. 7). Moreover, the White Paper proposed a co-ordinated approach to the development and management of waste disposal facilities and to this end the Nuclear Industry Radioactive Waste Executive (NIREX) was set up as an executive unit within the UKAEA comprising senior representatives from BNFL, CEBG, SSEB and UKAEA (Flowers 1982). The role of NIREX, then, is to secure the disposal of low and intermediate level wastes from all the partner organisations (ibid. p.2).

At the present time low level liquid and gaseous wastes that arise on nuclear sites are filtered, diluted and dispersed to the environment; low level solid wastes are disposed of by shallow land burial at the BNFL site at Drigg in Cumbria. Intermediate level solid wastes have been deposited in the deep waters of the NE Atlantic Ocean since 1949 under IAEA guidelines and although the London Dumping Convention in 1983 placed a two-year ban on such disposal while research continued, the British Government did not adhere to the ban. However, greater emphasis is now being placed upon land dumping of intermediate wastes and NIREX has been examining possible new sites. High level wastes from fuel reprocessing are currently stored at Sellafield but a vitrification process is planned to be in use by 1990 and disposal by either deep burial in stable geological formations or burial in the ocean floor is being considered. In 1981 the Government abandoned its exploratory drilling programme for land-based disposal on the grounds that its

feasibility was established and placed the emphasis on longer-term storage (Passant 1982 p. 8-14; Flowers 1982 p. 8-13).

As is the case with other issues there exists some variation in the extent to which the management and disposal of waste products from the nuclear fuel cycle is seen as problematical by proponents and opponents of nuclear power. However, in broad terms, the former tend to emphasise four main elements in their arguments: that the amounts of waste products which give cause for concern are relatively small; that the problem of the long life of fission products is exaggerated; that the management of wastes is amenable to known technical solutions; and that the problem is not great when considered in the perspective of the nature and quantity of hazardous wastes produced by other industries.

As indicated earlier the major source of radioactivity in waste products in the nuclear fuel cycle is the spent fuel elements from reactors; more than 95% of the total radioactivity in waste material arises at the fuel recovery stage of reprocessing (Flowers op. cit. p. 3).

Nevertheless, proponents of nuclear power emphasise that, in spite of their 'unpleasantness', the amount of such high level waste is very small - about four tons per year from Britain's present nuclear capacity (Hill 1981B p. 4; Greenhalgh 1980 p. 196; Hoyle 1977 p. 62-3).

In the CEGB's case for the Sizewell B PWR it is argued that the amount of irradiated fuel produced by that reactor and, indeed, by a future programme of 20 GWe of PWR's would not create any significant waste management problems (CEGB 1982A Chapter 27). On-site storage at Sizewell B could accommodate 18 years of fuel arisings and fuel could be stored on site for at least five years before transfer to reprocessing facilities for further storage prior to reprocessing (ibid p. 174).



Some proponents of nuclear power argue, moreover, that the problem of longevity of radioactivity in such wastes is often exaggerated. For example, Greenhalgh (1980 p. 195) argues that the discussion of the waste problem is distorted by misunderstandings about radioactive decay and the concept of 'half-life' and points out that highly active radioisotopes decay rapidly over short periods while those which have a long half-life approximate stable elements with any hazard arising from toxicity rather than their weak radioactivity. Hill (1978 p. 15-16; 1981B p. 4) similarly argues that the activity of most residual fission products decays rapidly and after a few years only Strontium-90 and Caesium-137 (with half-lives of around 30 years) remain problematical.

As regards longer-term management of high level waste there is a widespread confidence within the nuclear industry and amongst supporters of nuclear power that safe disposal routes will become available long before they are required. It is planned to solidify waste in glass blocks inside stainless steel containers, a process which has existed since the 1950's as a proven laboratory technique, the 'scaling up' of which the nuclear industry envisages as unproblematical (Pearce et al 1979 p. 160). It is envisaged that, due to their high residual radioactivity, such solidified wastes will be contained in an engineered storage system for a period of 50 years or more and that such a store could even be sealed up as a final disposal facility (CEGB 1982A p. 169-71; Marshall 1981 p. 262). Consequently, it is argued that there will be no need for means of permanent disposal until the beginning of the next century and, therefore, that there is no immediate urgency to demonstrate the availability of such a means (Hill 1981B p4).

Nevertheless further research to determine the best disposal routes from the viewpoints of safety, economy and public acceptability, is

regarded as important and indeed is progressing particularly into the options of disposal on or under the ocean bed now that the Government accepts the feasibility of deep land burial (CEGB 1982A p. 170). No technical obstacles are envisaged and public concern about such disposal routes is seen as misguided because, it is argued, the vitrified wastes, when safely buried, will pose very little threat to future generations both in an absolute sense and in comparison with other problems which such generations will face (cf. Hill 1978 p. 16-17; 1981B p. 4-5; Hoyle 1977 p. 63-4).

Criticisms which have been directed at the nuclear industry in respect of its approach to the waste management problem are therefore seen as unwarranted. Sir John Hill perceives a 'Catch-22' situation. The industry was criticised for not carrying out research on future disposal methods yet when it began to carry out test drillings to examine rock formations it came under attack again - a 'no-win' situation (Hill 1981B p. 5). As far as the nuclear industry is concerned, there is plenty of time available to establish a totally safe means of disposal but criticism from opponents of nuclear power could lead to the premature adoption of inadequately-tested methods (cf. Williams 1980 p. 272). Indeed, Greenhalgh (1980 p. 203) argues that it might be considered unreasonable to expect a demonstration of completely safe disposal methods:

"The elaborate geological disposal schemes now being worked out show the extraordinary lengths to which the industry is prepared to go to demonstrate that a 'completely safe' waste disposal scheme is feasible. Indeed there is now a growing feeling that the nuclear industry has over-reacted to the demands that it must demonstrate 'completely safe' disposal procedures. It can be argued that such a requirement is both unreasonable and unrealistic. It is unreasonable because the radioactivity of the wastes will cease to be a significant hazard long before it has

completely decayed, and it is unrealistic to demand scientific proof of safety procedures extending over a period of several hundred thousand years."

The problem of high-active wastes is therefore seen in the nuclear industry as of relatively little concern because of the small quantities involved. Excessive concern by critics with such wastes has, it is argued, distracted attention from the more difficult problem facing the industry of handling the much larger volumes of low and intermediate level wastes (Hill 1981B p. 6; Greenhalgh 1980 p. 205-8; Pearce 1979A p. 38). Intermediate level wastes, for example, are currently dumped in the sea but this practice, as indicated earlier, may not remain feasible in the long-term. The CEEB has therefore been examining the possibility of shallow land burial of intermediate waste and has concluded:

"There is no doubt that suitable shallow land burial sites could be found and shown to be technically feasible and radiologically safe." (CEGB 1982A p. 169).

Indeed, in late 1983 NIREX announced that it had identified eight possible sites in the UK for intermediate waste dumping (see Guardian 25/10/83).

Finally, supporters of nuclear power see their critics as unreasonable to the extent that they focus on the problem of nuclear waste to the neglect of what is seen as the greater problem of waste from other industries. Thus, whereas radioactivity eventually dies away, many toxic heavy metal wastes from metal mining and extraction (e.g. mercury and cadmium) and the lead added to petrol do not decay and their potential danger never decreases (Greenhalgh 1980 p. 195-6; Brookes 1976 p. 11). Consequently, the hazards from nuclear wastes should, it is argued, be set in context against those from other activities,

and in such a context they become relatively insignificant (ibid).

In general terms, then, the waste disposal issue is, for proponents of nuclear power, a 'non problem' (Hill 1981B p. 4); at the most it is a problem which is amenable to a technical solution which will eliminate any impact on present and future generations. As Sir Walter Marshall (1981 p. 263) has stated:

"I am confident that by the time we need to dispose of high level nuclear wastes we shall have an entirely safe and acceptable means of doing so, and will be able to demonstrate that this offers no risk to society, even thousands of years into the future."

In view of such confidence it is argued that criticism and concern in relation to this issue is essentially based upon "... ignorance and a fear of the unknown." (Hoyle 1977 p. 62-3; cf. Hill 1981B).

Critics of nuclear power, however, argue that such confidence and optimism is unjustified and misplaced. In broad terms, their position can be characterised by three main arguments: firstly, that it is irresponsible to continue producing nuclear wastes in advance of a demonstration of the feasibility of safe long-term disposal; secondly, that there are certain technical problems which prejudice the achievement of safe disposal; and, thirdly, that, notwithstanding such technical difficulties, the problem is more one of a moral and ethical nature due to the potential impact on future generations of long-lived waste fission products.

In the first place, then, it is argued that the nuclear industry has paid inadequate attention to the problems of long-term waste management (Elliott 1978 p. 15; Flowers 1976 p. 193). As a result, there has been a failure to fully assess the economic and social costs of waste

management and this has produced, it is argued, an underevaluation of such costs and an effective subsidy to nuclear power development (Shrader-Frechette 1980 p. 49-53; cf above section 7.4). Until there has been a demonstration of a safe, permanent method for long-term disposal to provide a basis for realistic estimates of economic and social costs, it is regarded as irresponsible for the nuclear industry to continue producing wastes (Bickerstaffe and Pearce 1980 p. 318). The absence of such knowledge is seen as distorting the decision-making process potentially leading to a reduction in our future options and pressures to accept 'second best' solutions with higher attendant social costs (Schrader-Frechette 1980 p. 55-9).

However, it is further argued by critics that this condition of demonstration and guarantee of safe disposal cannot be met by the nuclear industry and that confidence in the availability of technical solutions to the problem is unwarranted. The first stage in the industry's preferred route to disposal involves surface storage of high-active wastes in tanks and this carries risks of leakages and cooling failures (producing potentially severe accidents) and a requirement for extensive surveillance (Bunyard 1981 p. 148-50; Prior 1980A p. 11). As regards the problem of ultimate disposal various criticisms have been directed at the proposal for deep burial of vitrified waste. For example, the ability of the blocks to withstand disintegrative pressures from radiation and heat over the required periods has been questioned and similar doubts have been expressed about the effects on the rock material in which the blocks are buried (Bunyard 1980 p. 124; 1981 p. 150-1). Lovins (1975 p. 33-4) argues that there is no evidence that solidified wastes will remain monolithic, insoluble or inert over the required periods of isolation, especially for actinides which have the highest levels of toxicity;

indeed, he suggests that the development of a perpetually closed system has never before been accomplished in the management of other hazardous substances particularly those which can be biologically reconcentrated. Moreover, he argues (ibid p. 34) that since we can have no geological guarantees, terrestrial disposal must be 'retrievable' in case of geological contingencies; but such a condition of 'retrievability' imposes a requirement for surveillance on a time scale far exceeding the observed life span of human cultures and this creates unique social and moral implications which are neglected in 'technical' definitions of the problem.

Indeed, some opponents of nuclear power see the waste management issue primarily as a moral and ethical one with the technical problems attaining only subsidiary importance. The major issue here, then, is that of 'intergenerational fairness' - whether any generation has the right to leave such a potentially hazardous legacy to its descendants (Bickerstaffe and Pearce 1980 p. 318; Shrader-Frechette 1980 p. 61). The storage of nuclear wastes implies a technological as well as social 'irreversibility' in the sense that future generations will have to suffer the potential hazards of wastes from the present whether or not they themselves employ nuclear power (Bickerstaffe and Pearce op. cit). Indeed, Routley and Routley (1978 p. 137) argue that given the potential life of nuclear fission, many more generations will have to bear the risks from nuclear wastes than will benefit from nuclear-generated electricity. They go on to argue that we have a necessary moral obligation to take into account the interests of future generations, as much as those of present generations, in taking actions which will affect them and that this obligation is in no way diminished by uncertainty about the future (ibid p. 139 p. 139-54). Since nuclear waste storage does impose significant risks of harm on future people

moral constraints are applicable and cannot be devalued by reference to claims of countervailing economic benefits; this is seen as illegitimately internalising moral considerations within economics rather than placing economics within a broader framework of moral constraints (ibid p. 155, 161). From this perspective, the emphasis by the nuclear industry on the 'technicalities' of the issue is seen as disguising the true ethical nature of the problem and producing a biased evaluatory context (Prior 1980A p. 11; Shrader-Frechette 1980 p. 59-61).

The critics' position in respect of the waste management issue in fact found some support in the sixth report of the Royal Commission on Environmental Pollution which summarised as follows:

"We believe that a quite inadequate effort has been devoted to the problems of long-term waste management, and that there should be no substantial expansion of nuclear power until the feasibility of a method of safe disposal of high level wastes for the indefinite future has been established beyond reasonable doubt."  
(Flowers 1976 p. 192-3).

The position on the high level waste problem is, moreover, supplemented by other concerns. For example, it is argued by some that there is inadequate concern about the problem of disposing of intermediate level wastes (e.g. fuel element cladding and the residues from reactor decommissioning) which arise in greater volumes than high-active wastes (Pearce 1979A p. 38; Lovins 1975 p. 34). As indicated earlier such waste is presently dumped at sea by NIREX under IAEA and OECD guidelines and the Government did not recognise the two-year ban on such dumping imposed by the London Dumping Convention in February 1983 (Guardian 25/9/83). The Government has been advised by the Radioactive Waste Management Advisory Committee that such sea dumping could safely

continue and indeed be increased (Flowers 1982 p. 14-5); however, critics such as Greenpeace have disputed this argument and the UK transport unions managed, during 1983, to prevent the sea-dumping of low and intermediate level wastes from proceeding (Guardian 25/9/83). Also, current practices for the transport of spent reactor fuel by rail from power stations to the Sellafield reprocessing plant have attracted considerable criticism due to the risks of accidents in heavily-populated areas and doubts about the ability of the spent fuel flasks to withstand the worst possible accident (Bunyard 1981 p. 130-1).



#### 8.2.4 Other Environmental Implications

Arguments about other environmental impacts do not figure prominently in the controversy over nuclear power so they can be considered very briefly. Supporters of nuclear power tend to argue that its environmental advantages derive primarily from the small quantities of materials involved in the nuclear fuel cycle compared with the effects of extracting, transporting and burning fossil fuels (Greenhalgh 1980 p. 143-5). One of the primary advantages is seen to lie in the reduction of the problem of carbon dioxide accumulation in the atmosphere due to fossil fuel combustion and the consequent avoidance of a potentially catastrophic climatic change due to a rise in temperatures caused by the 'greenhouse effect' (ibid p. 171-2; Weinberg 1980 p. 33-4). In addition, it is argued that nuclear power can contribute to a reduction in acid oxide emissions from fossil fuelled power stations (especially sulphur dioxide) which currently cause health problems, crop damage and corrosion (Jones 1980B p. 152; Tombs 1978 p. 3). Finally, nuclear futures are seen as creating fewer problems in respect of land requirements than alternatives involving for example, more coal mining and renewable technologies such as wind power and biomass (Greenhalgh 1980 p. 147; Bethe 1978 p. 97).

Opponents of nuclear power, while admitting that there are environmental benefits to be obtained from the reduction of fossil fuel combustion, nevertheless argue that the advantages claimed by the nuclear proponents are overstated. For example, the adverse consequences of carbon dioxide build-up can be exaggerated by neglecting the benefits that it might bring for agricultural productivity (Wittwer 1982). The problems currently associated with the burning of fossil fuels to generate electricity can be significantly reduced, it is argued, by

for example, reducing coal requirements through the implementation of combined heat and power schemes and reducing acid oxide emissions through the introduction of fluidised bed combustion systems (Friends of the Earth 1981 p. 527-8; Leach et al 1979 p. 30). A greater emphasis on renewable energy sources is seen as the best way to avoid potential climatic and ecological problems since such sources do not directly contribute to the thermal pollution which exacerbates the 'greenhouse effect' (Lovins 1979B p. 197; cf. Lecomber 1979 p. 177-8). Finally, some critics (for example, the Council for the Protection of Rural England) argue that the land requirements of nuclear electricity generation do cause significant problems particularly because, firstly, large central power stations require more main transmission lines and, secondly, the requirement for coastal siting creates a conflict with amenity and nature conservation interests (Caulfield 1982; CPRE 1982).

### 8.3 The Social and Political Implications of Nuclear Power

#### 8.3.1 The Proliferation of Nuclear Weapons

"If man ever achieves this further control over Nature... War, unless in the meantime man had found a better use for the gifts of science, would not be the lingering agony it is today. Any selected section of the world, or the whole of it if necessary, could be depopulated with a swiftness and dispatch that would leave nothing to be desired." (Soddy quoted in Trenn (1979 p. 267)).

Thus it was that in 1917 Frederick Soddy expressed his concern about the destructive potential of the process of atomic fission which he and Rutherford had confirmed fifteen years earlier. With the actual demonstration of this potential in 1945 the issue of the linkage between the development of nuclear power and the proliferation of nuclear weapons came to the forefront in international politics. Since that time continuing efforts have been made to find acceptable means of controlling the development and dissemination of nuclear technology as a source of energy for peaceful use while at the same time preventing, or at least minimising the risk of proliferation of nuclear weapons (Imai and Press 1980 p. 2). Although there are indeed some who regard nuclear weapons proliferation as beneficial from the point of view of reducing the likelihood of war (cf. Quester 1981 p. 2) most participants in the debate do believe that it is desirable to avoid or restrict proliferation. However, on the question of the relationship between civil nuclear power development and the spread of nuclear weapons there exists considerable disagreement.

After the end of the Second World War the thinking behind the development of a non-proliferation regime was dominated by the conviction that the scope for proliferation was limited by the technological complexity of

weapons manufacture and by the difficulty of obtaining fissile material suitable for weapons from commercial reactors (Pearce et al 1979 p. 167). In 1946 the US Baruch Plan, based on the Acheson-Lilienthal proposals for international co-operation in and supervision of nuclear energy developments, failed to gain international acceptance (Imai and Press 1980 p. 2-3). Eisenhower's Atoms for Peace programme, launched in 1953, was intended to assist countries in their development of civilian nuclear energy in return for guarantees that such assistance would be used only for peaceful purposes. (Nye 1981 p. 17). This had the effect of promoting the rapid development of nuclear power programmes but it also provided the basis for a system of international safeguards and controls which was subsequently institutionalised with the establishment of the International Atomic Energy Agency (IAEA) in Vienna in 1957 (ibid; Imai and Press 1980 p. 4). The IAEA safeguards system was designed to ensure the monitoring and inspection of civil nuclear facilities in nonweapons countries to prevent diversion of materials to weapons uses (Nye op. cit.).

However, as assistance with nuclear programmes progressed, as the numbers of research reactors multiplied, and as the UK, France and China developed nuclear weapons, fears of horizontal proliferation were strengthened. This led to the formulation, during the 1960s of the Non-Proliferation Treaty (NPT) which was finalised in 1968. The NPT was designed to limit the development of nuclear weapons (as a forerunner to achieving nuclear disarmament), and to ensure the acceptance of the IAEA safeguards system by nonweapons states in return for supplies of nuclear materials and technical assistance in the peaceful use of nuclear power (ibid p. 18). Not all nations are party to the NPT but France subscribes to its spirit and in Latin America the Treaty of Tlatelolco is designed similarly to limit nuclear

weapons; moreover, most nuclear facilities in non-NPT countries are subject to safeguards as a condition of obtaining fuel and equipment from suppliers (ibid; Bickerstaffe and Pearce 1980 p. 313-4).

The NPT-IAEA non-proliferation regime formed the basis for confidence on the part of proponents of nuclear power that there was no necessary link with weapons development until the mid 1970s. However, certain events and trends then contributed to a growing concern about the adequacy of this regime (Nye 1981 p. 18-19; Imai and Press 1980 p. 5-7; Pearce et al 1979 p. 168). Firstly, the explosion by India in 1974 of a 'peaceful' nuclear device using plutonium derived from a Canadian-supplied research reactor was seen as undermining the regime. Secondly, the 'oil crisis' generated a surge of expectations about future nuclear power development which brought into question the capacity of existing safeguards and institutions to handle such developments. Thirdly, proposals were made for the sale of 'sensitive' nuclear facilities (for producing weapons-usable materials) to several countries with only limited nuclear power programmes creating the suspicion that they were required for weapons purposes in violation of the existing regime. Other trends which were subversive of the regime included the increasing separation of plutonium from spent fuel, more economical methods of enriching uranium and the prospect of the introduction of fast reactors.

In response to these trends and events certain initiatives were taken in the USA to update and strengthen the non-proliferation regime. Firstly, the Nuclear Suppliers Group was created in 1976-7 to attempt to prevent the undercutting of safeguards obligations (Nye 1981 p. 21; Imai and Press 1980 p. 6). Secondly, in October 1976 President Ford declared that avoidance of proliferation should take precedence over

economic interest and announced the deferment of commercial reprocessing pending a solution of proliferation problems (ibid). This deferment was confirmed by President Carter in 1977 in a policy statement which was concerned to avoid the premature commercialisation of fuel cycles utilising plutonium and therefore also cancelled the commercial demonstration fast reactor project at Clinch River. Moreover it proposed stricter controls on the development of reprocessing capacity in other countries (Nye 1981 p. 22-3; Pearce et al 1979 p. 168-9). The Nuclear Non-Proliferation Act of 1978 subsequently embodied these proposals <sup>in</sup> stringent controls on the spread of enrichment reprocessing and fast reactor technologies (ibid).

The American stance on non-proliferation also led to the establishment of the International Nuclear Fuel Cycle Evaluation (INFCE) to promote an international assessment of the proliferation risks of various aspects of the nuclear fuel cycle, in order to determine measures to minimise such risks without jeopardising the development of nuclear energy for peaceful purposes (Nye 1981 p. 25). Nye argues that INFCE helped to re-establish a basis for consensus on a refurbished non-proliferation regime for the nuclear fuel cycle; specifically, it has reduced pressures for the premature use of plutonium which threatened the safeguards system:

"... INFCE laid a basis both in time and institutional suggestions for a cautious introduction of plutonium use that would be guided by realistic development needs rather than wasteful and dangerous imitation based on a spurious conventional wisdom and exaggerated projections." (ibid p. 26).

Having briefly reviewed the evolution of the current system of international controls and safeguards we can now consider the major arguments of proponents of nuclear power in respect of the proliferation

risks from its development. It is generally argued, then, that although the first civil nuclear programmes (in the USA, USSR, UK and France) were started for military purposes and a civil programme can provide the necessary materials, equipment and expertise for weapons production, there is nevertheless no inevitable tie between civil and weapons programmes (Greenhalgh 1980 p. 20). No country now possessing nuclear weapons has development them, it is maintained, by diverting fissile material from civil facilities and of the 22 countries which have obtained commercial reactors since 1945, 17 have not developed nuclear weapons (ibid; Imai and Press 1980 p. 17-18). Should a country wish to undertake such development it is easier, cheaper, and quicker to produce weapons grade fissile material in special facilities which would be more easily concealed (Greenhalgh 1980 p. 210-1; Jones 1980B p. 153; Bickerstaffe and Pearce 1980 p. 314). Moreover, the system of international safeguards based on NPT/IAEA is widely seen as providing the basis for effective guarantees against the use of civil facilities for weapons purposes (Imai and Press 1980 p. 18). As Greenhalgh (1980 p. 219) argues:

"... proliferation is basically a political matter; while there is no fuel cycle that is entirely proliferation resistant, there is at the same time no fuel cycle that cannot be reconciled with a non-proliferation regime given improved institutional arrangements and improved safeguards."

Considerable emphasis is placed, then, on strengthening the existing safeguards system in order to permit the expansion of civil nuclear programmes, particularly in non-nuclear weapons states (NNWS), without additional proliferation threats. Imai and Press (op. cit) argue that recent restrictions on transfers of technology, materials and equipment imposed by America are unduly penalising developing countries and threatening their capability to pursue programmes of economic

development based on nuclear power. They suggest that the proliferation dangers arising from energy shortages and imbalances, which might arise if the development of civil nuclear programmes is restricted, far outweigh those arising from international supervised fuel cycles (*ibid.* p. 15-20). It is argued, therefore, that fuel cycle services should be made available on an assured basis to NNWS and that the international non-proliferation regime based on NPT/IAEA should be strengthened by enhancing the political commitment of sovereign states to non-proliferation goals (*ibid.* p. 23-4; Nye 1981 p. 29-31).

Certain technical arguments are also developed in relation to the proliferation issue. In particular, it is argued that the development of fast reactor technology has significant advantages from the non-proliferation point of view because it allows a greater degree of control over plutonium (Greenhalgh 1980 p. 95; Imai and Press 1980 p. 19-20; Marshall 1978, 1980). The argument has been developed by Marshall (*ibid.*). He argues that thermal reactor policies can add to proliferation risks because the once-through fuel cycle results in an accumulation of stored plutonium which becomes increasingly accessible over time. Consequently, it is necessary to retrieve plutonium and subject it to close control but the ideal solution is to use it as fuel in fast reactors thus rendering it inaccessible and producing a technical means of controlling and limiting plutonium, reducing the amount of 'extractable' plutonium and, therefore, greatly reducing the risks of diversion for weapons purposes (*op. cit.* 1978 p. 7-19). Indeed, with Chauncey Starr, Marshall has proposed the development of a completely automated process for the reprocessing and fabrication of fast reactor fuel (the Civex process) which, he argues, could further reduce proliferation and diversion risks (*ibid.* p. 25-6; cf. Bunyard 1981 p. 146-7).



Such technical developments, then, combined with improved safeguards and 'codes of practice' are seen as reducing to a negligible level the contribution of civil nuclear power programmes to the problem of nuclear weapons proliferation. Opponents of nuclear power disagree. Their arguments on this issue are underlain by the view that the commonality of materials between nuclear reactors and nuclear weapons is a major factor in elevating the technology to a 'special' status (cf.p.279).

They see an 'intimate connection' between civil and military spheres which can never be separated by absolute barriers (Prior 1980A p. 11; Patterson 1978 p. 127). Although the link is not seen as deterministic it is nevertheless argued that the development of civil nuclear programmes constitutes a major driving force behind weapons proliferation (cf. Nye 1981 p. 29).

As an example of the close connection between civil and military programmes, opponents of nuclear power point to developments in the UK where, it is argued, it is not possible to distinguish between civil and military plutonium (Dombey 1981; Sweet 1982 p. 50-52). The Magnox reactor system was initially developed in relation to the requirements for weapons plutonium and considerable amounts of high-quality plutonium have been produced as a by-product of electricity generation (ibid). It is suggested that this plutonium is being diverted to weapons uses in violation of the articles of the NPT (Sweet op. cit.). Moreover, controversy has developed recently over exports of plutonium to the USA to fuel its fast reactor programme (which it now wishes to resurrect); critics allege that such exports will permit the US to convert its Harford reactor to weapons plutonium production thus permitting the development of weapons which would otherwise not have been possible. This again is seen to constitute a threat to NPT (Dombey 1981; Sweet 1982 p. 51-2).

Moreover, opponents of nuclear power emphasise that it is now widely recognised that nuclear weapons can be constructed using reactor grade fissile material. The technical information and expertise required to design and manufacture a nuclear explosive device is now quite readily available (Barnaby 1977 p. 4). Reactor-grade plutonium (and highly enriched uranium) can be used to manufacture militarily useful weapons with reliable yields in the kiloton range which would provide an entirely credible national nuclear weapons capability (Lovins 1980 p. 817-21; Selden 1976). Indeed, in 1977 the US Government announced that it had successfully tested such a device (Sweet 1982 p. 52). Furthermore, it is argued that there are political and economic advantages of using power-reactor plutonium to make weapons which might outweigh the technical problems and, given the problems of detection, governments might actually prefer this route in certain circumstances (ibid. p. 50; Lovins 1980 p. 822). Finally, Barnaby (1977 p. 4) argues that there are likely to be considerable pressures, connected with scientific prestige and curiosity, technological momentum and security considerations, for the development of a weapons capability out of a civil programme producing significant proliferation threats.

As indicated earlier, increasing quantities of plutonium are being produced as a by-product of electricity generation by thermal reactors employing the once-through fuel cycle and some supporters of nuclear power are concerned at the proliferation risks of this build-up (see above p.287 ). As the prospect of operational fast reactor technologies draws closer demand is increasing in many countries with significant nuclear power programmes for new reprocessing facilities to provide plutonium fuel for fast reactors (Barnaby 1977 p. 4; Prior 1980A p. 12-13). Many critics are concerned that such an expansion of

reprocessing would considerably increase the proliferation threat by producing easier access to separated plutonium and by spreading the required knowledge and expertise for weapons manufacture (Marshall 1978 p. 24; Bickerstaffe and Pearce 1980 p. 314). Indeed, the US Nuclear Non-Proliferation Act of 1978 is seen as some vindication of such fears as are reports that Pakistan has developed an enrichment plant based on expertise 'acquired' by one national who gained access to details of sensitive researches at the URENCO plant in the Netherlands (ibid).

As regards the proposals made by supporters of nuclear power for the prevention of weapons proliferation, the critics remain unconvinced. For example, Jasani (1980) criticises proposed technical solutions. Firstly, the suggestion that spent fuel from the once-through fuel cycle of thermal reactors would be left unprocessed, thus protecting the plutonium with high radioactivity, is rejected because radioactive decay would eventually render the plutonium potentially retrievable (ibid. p. 184; Pearce 1979A p. 39). Moreover, supporters of the fast reactor are unlikely to back such an option. Secondly, it is argued that there is no way of 'denaturing' fissile material so that it cannot be used for weapons manufacture (Jasani 1980 p. 184; Lovins 1980 p. 822; Selden 1976). Finally, the notion of a proliferation-resistant automatic fuel reprocessing and fabrication process, such as CIVEX, is regarded as speculative, subject to technical criticism and of relevance only well after 2000 (Bunyard 1981 p. 147; Pearce 1979A p. 39). Furthermore, Jasani (ibid p. 185) argues that it cannot overcome the problem which is common to all proposed technical solutions:

"(A)lthough schemes such as Civex may make it difficult for a small group of people, or even a country with a less developed technological base, to divert plutonium, it is always possible for a sophisticated organisation to extract weapons-grade plutonium if it is really determined to do so. No technical measures can solve such proliferation dangers."

The institutional and political measures embodied in the international non-proliferation regime are also subject to criticism as inadequate to prevent proliferation by opponents of nuclear power. Firstly, the NPT is criticised as merely an undertaking of good behaviour which has not been effective in preventing proliferation and is, in any case, so fragile that its survival as a workable instrument is in doubt (Barnaby 1977 p.5; Dombey 1981). In the case of considerations of 'national security' and commercial interests (for example, for the sale and enrichment and reprocessing plant) the NPT can, it is argued, easily be circumvented (Prior 1980A p. 13-4). Much depends in practice on the IAEA verification and inspection procedures but these again come in for criticism. Doubts are expressed about the IAEA's capacity to detect the diversion of fissile material and to give a timely warning of such diversion given the response time of the international diplomatic system (Pearce et al 1979 p. 168; Bickerstaffe and Pearce 1980 p. 314). With future increases in plutonium production the uncertainties would be magnified (ibid). Moreover, critics also believe that the IAEA is in a potentially self-contradictory position in attempting to both promote nuclear power and prevent proliferation producing a likelihood of bias in favour of promotion (ibid).

The concern of opponents of nuclear power in respect of the proliferation issue was expressed by the Royal Commission on Environmental Pollution in the following terms (Flowers 1976 p. 76):

"(T)he spread of nuclear power will inevitably facilitate the spread of the ability to make nuclear weapons and, we fear, the construction of these weapons. In reality, total agreement on a comprehensive international control system for the products of civilian nuclear power that are relevant to the construction of nuclear weapons would be possible only in a climate of general disarmament, and the prospects for this are receding rather than improving. It has been argued that the possession of these weapons by the USA and the USSR has been a powerful force for

for mutual toleration, but however true this is, it would be folly to suppose that proliferation would necessarily lead to a similar balance and restraint in relations between other nations. Indeed, we see no reason to trust in the stability of any nation of any political persuasion for centuries ahead. The proliferation problem is very serious and it will not go away by refusing to acknowledge it."

Finally, it should be noted that opponents of nuclear power reject the argument that any direct proliferation risks are more than outweighed by the indirect risks which would arise from energy shortages and imbalances contingent upon the failure to promote widespread development of nuclear power. Based on the economic arguments considered in Chapter 7 (Section 7.2) critics deny that such indirect risks exist because, firstly, nuclear power is not necessary to avoid energy shortages and, secondly, the rejection of the nuclear option will bring economic benefits and increase economic stability.

### 8.3.2 Terrorism and Civil Liberties

This issue is not widely considered by supporters of nuclear power to be particularly relevant to the discussion of its implications. For example, Geoffrey Greenhalgh (1980), in a book which purports to cover the relevant issues, gives no specific consideration to potential problems of terrorism and threats to civil liberties. When the issue is addressed it tends to be so in a rather dismissive fashion. The nature of the potential problem can be stated briefly. Firstly, terrorists might regard nuclear fuel cycle facilities as potential targets for sabotage or occupation or they might steal (or otherwise acquire) fissionable material with which to manufacture explosive devices (Bickerstaffe and Pearce 1980 p. 315; Flood and Grove-White 1976 p. 5-6). Secondly, the security measures which might be necessary to counter the threat (or occurrence) of terrorist activity could

contribute to a significant erosion of civil liberties, both of workers in the nuclear industry and of the general public (Bickerstaffe and Pearce op. cit.).

In broad outline the position adopted by proponents of nuclear power takes the following form. In the first place (and as on the proliferation issue) it is argued that by far the greatest threat to social stability, and to traditional rights and freedoms, derives from the prospect of energy shortages and imbalances which will arise if nuclear power is not developed as quickly as possible. As Greenhalgh (1980 p. 238-9) argues, without nuclear power "severe disruption" will result with enforced zero or negative economic growth, recession and unemployment; "...the consequences of a world plunged into severe and widespread energy shortages would be catastrophic." Compared with such a prospect, then, the threat of terrorism is not seen as important. Moreover, it is argued that such a threat is not unique to nuclear installations and that equally large risks are attached to, for example, large dams or natural gas termini; in comparative terms, therefore, nuclear plant is not seen as presenting any special risks (Bickerstaffe and Pearce 1980 p. 315).

Indeed, the absolute level of the threat is also seen as insignificant. The dangers inherent in trying to acquire plutonium, the security measures at nuclear installations, and the construction standards adopted are seen as sufficient to deter terrorist activity and prevent significant adverse consequences from such activity (ibid. Jones 1980B p. 153). Further measures are seen as readily available should they become necessary. Technical options include the 'spiking' or 'denaturing' of fuel to build in an inherent radioactive barrier to terrorist diversion (cf. Bunyard 1981 p. 146). Increased security

and surveillance can also be arranged and Weinberg (1978 p. 79-80) suggests that the terrorist threat would be minimised in his 'center siting' strategy in which large energy centres would be controlled and supervised by highly-trained, expert personnel.

Such 'technical and institutional fixes' are seen, then, as sufficient to protect society against terrorism and as themselves presenting no incremental threat to civil liberties (Jones 1980B p. 153). The issue is basically irrelevant to the nuclear power debate and "...not a matter that would figure prominently in a full social cost-benefit study on the choice of direction for future UK energy strategy..." (ibid). According to Tombs 1978 (1978 p. 5) the problems of terrorism and the prospect of the erosion of civil liberties have been exaggerated by opponents of nuclear power. Indeed, Greenhalgh (1980 p. 224) regards as totally inappropriate the involvement of, for example, the National Council of Civil Liberties, in the Windscale Inquiry in particular and in matters of energy policy in general.

However, in the view of many opponents of nuclear power the civil liberties issue is of fundamental importance to the question of its desirability since the perceived threat involves basic social and political institutions. In the first place it is argued that there is a significant threat from terrorist activity involving nuclear installations and fuel cycle activities. The main security threats were indicated at the beginning of this section and basically involve theft and malicious use of plutonium, sabotage of nuclear installations or blackmail based on threats of the above activities or occupation of nuclear plant (Flood and Grove-White 1976 p. 5-6; Bickerstaffe and Pearce 1980 p. 315). For example, reference has already been made to concern about the ability of competent amateurs to construct a nuclear

explosive device from reactor grade plutonium; Bunyard (1981 p. 199) refers to 'credible' bomb designs by US students and Lovins (1980 p. 820) quotes Willrich and Taylor as follows:

"Under conceivable circumstances, a few persons, possibly even one person working alone, who possessed ~ 10 kg of plutonium oxide and a substantial amount of chemical high explosive could, within several weeks (or perhaps less), design and build a crude fission bomb... (that) would have an excellent chance of exploding,..... probably.... with the power of at least 100 tons of chemical high explosives. This could be done using materials and equipment that could be purchased at a hardware store and from commercial suppliers of scientific equipment for student laboratories....."

Bomb attacks against nuclear plant have occurred in Germany, Spain and France and nuclear installations have been entered though no serious incident of sabotage involving releases of radiation is yet known to have occurred (Flood and Grove-White 1976 p.6).

It is argued, moreover, that the threat to use a nuclear device or commit sabotage is most effective as a means of blackmail and a credible threat can easily be made given the wide availability of information on bomb manufacture and the inability to account for all fissile material throughout the fuel cycle (Bickerstaffe and Pearce 1980 p. 315; Lovins 1975 p. 37-8). The precision of inventory assay (about one percent) is such that over a period of time a significant quantity of fissionable material is unaccounted for; continual small thefts of such material can therefore remain undetected (ibid. Widdicombe 1980 p. 193). Widdicombe (ibid) refers to claims that there already exists a blackmarket in fissile materials and to records of 44 nuclear threats against US cities or industrial plants since 1970 which were credible enough to be taken seriously.



Consequently, for opponents of nuclear power, the threat of terrorist activity is real and susceptible neither to elimination by safeguards nor to justification by comparisons. The observation that the terrorist threat applies to other industrial installations is seen as in no way diminishing the 'more spectacular risks' attached to nuclear facilities (Lovins 1975 p. 38). Moreover, it is argued that terrorist and criminal activities have increased in other areas in spite of expensive and thorough safeguards; therefore "...it is impossible to prevent the theft of strategic materials by sufficiently determined groups whose motives are subversive or economic". (ibid p. 38-9), Such misgivings were reflected in the report of the Royal Commission on Environmental Pollution (Flowers 1976 p. 81): "In sum, plutonium appears to offer unique and terrifying potential for threat and blackmail against society..."; and Willrich and Taylor have concluded that "...it seems only a question of time before some terrorist organisation exploits the possibilities for coercion which are latent in nuclear fuel." (cf. Bickerstaffe and Pearce 1980 p. 315),

The security measures and precautions which necessarily accompany the development of the nuclear fuel cycle in order to counter such threats are seen by opponents of nuclear power as inimical to civil liberties and democratic rights. Two major types of precaution are necessary; firstly, nuclear installations and materials in transit require special guarding;; and, secondly, there is a need for security vetting of personnel and surveillance of certain members of the public (Widdicombe 1980 p. 193). At the present time, for example, the guarding of nuclear installations and materials in transit is undertaken by the Special Constabulary of the Atomic Energy Authority which has unique powers to carry and use weapons, to engage in 'hot pursuit' of actual or potential thieves, and to arrest on suspicion. Such powers are

seen as a cause for concern because the force is not responsible to Parliament for its day-to-day operations (ibid p. 194; Flood and Grove White 1976 p.8). Personnel employed at nuclear installations and those engaged in transit operations are currently subject to 'vetting' procedures and the restrictions of the Official Secrets Act (ibid p. 7-8).

Critics express considerable misgivings about possible future trends in such measures and precautions if an expansion of nuclear power programmes is undertaken. Firstly, it is suggested that there could be substantial extensions of vetting procedures in the electricity supply industry and associated industries and an expansion of special police forces not subject to full political control (Flood and Grove-White 1976 p. 9-11). In addition, it is suggested that the expansion of nuclear power will result in an erosion of the interests of workers in respect of, for example, the right to strike and participation in management decisions (Mathews 1980 p. 26; Bunyard 1981 p. 202). The increased movement of fissile materials round the transportation system is seen as having potentially disturbing consequences in view of the need for special restrictions and security (Lovins 1975 p. 31-2). Moreover, members of the public will, it is feared, become subject to more extensive surveillance involving, for example, phone-tapping, mail-opening and the use of informers and infiltrators (Flood and Grove-White 1976 p. 11-17). It is felt that such surveillance is likely to be extended to cover politically radical groups, and environmentalist groups opposed to nuclear power, indeed, to any groups or individuals which are defined as actually or potentially 'subversive', with such a definition being made by the security forces subject to little control (ibid p. 12-13; Widdicombe 1980 p. 194-5). Taylor (1980 p. 83), for example, cites the case of the German scientist Dr Traube who, on becoming opposed to nuclear power, suffered the experience of phone-tapping and arrest on

suspicion of having terrorist links.

Concern has also been expressed about the 'fragile' nature of a nuclear society in which the above risks build up. Thus, a single serious incident could bring about the introduction of draconian security measures and surveillance which might well be subsequently maintained on a permanent basis, applied to other law enforcement problems and therefore threaten to disrupt and change the basic structure of our social and political institutions with drastic implications for civil liberties (Bickerstaffe and Pearce 1980 p. 316; Lovins 1975 p. 16-17). The requirement that certain risks and threats must not be allowed to materialise is seen as producing necessary tendencies towards an increasingly centralised and authoritarian political system (Prior 1980A p. 15; Mathews 1980 p. 26; Routley and Routley 1978 p. 164-5). In such a context it is feared that opposition to nuclear power may increasingly involve civil disobedience and violence which could evoke an even stronger security reaction; and this might produce a perpetual escalation of violence and authoritarian reaction (cf. Pearce et al 1979 p. 219-23; Flood and Grove-White 1976 p. 45-7).

A further focus of concern for opponents of nuclear power is the highly centralised electricity generation and distribution system which is implied by heavy reliance on nuclear power. It has been argued that such a system would be vulnerable to subversion from inside or outside the industry and that the measures required to prevent the severe consequences of disruption could present a threat to civil liberties and rights (ibid. p. 6; Patterson 1978 p. 133). Also, the energy futures advocated by supporters of nuclear power structured around this heavy reliance upon centralised, nuclear-generated electricity, are seen to imply an erosion of the freedom of consumer

choice, with no opportunity for consumers to indicate their preferences in market behaviour (Patterson 1977 p. 95).

In view of this level of concern about the civil liberties issue, opponents of nuclear power are highly critical of what they see as the total neglect of the problem by government, the nuclear industry and nuclear proponents in general. Indeed, such neglect has caused disquiet amongst impartial analysts and commentators. For example, the Royal Commission on Environmental Pollution stated that "...we think it remarkable that none of the official documents we have seen during our study convey any unease on this score.... Nowhere is there any suggestion of apprehension about the possible long-term dangers to the fabric and freedom of our society." (Flowers 1976 p. 193). Pearce (1979A p. 39) accepts that "... (a)n expanded nuclear power programme necessarily involves an increase in the infringement of civil liberties..." and finds Jones' (1980B) dismissal of the problem "... difficult to understand". This neglect, combined with official secrecy about security measures, has promoted support for conspiracy theories about the role of the security services as concerned more to undermine rather than preserve civil liberties (Pearce et al 1979 p. 175-6). Such suspicions have led opponents of nuclear power to call for full and open discussions about security measures in order to ensure that the security services are subject to public accountability and support (ibid. p. 176-7).

To critics of nuclear power, then, the threat to civil liberties represents a significant element in the debate. They dismiss the suggestion that failure to proceed with nuclear programmes will produce a greater threat to liberties and freedoms due to the economic and social consequences of energy shortages on the grounds that such

shortages are not the necessary consequence of a non-nuclear policy. As discussed previously, many opponents of nuclear power argue that such shortages and associated price leaps are avoidable given serious measures to conserve energy, reduce waste, increase efficiency and develop alternatives to nuclear power and, further, that the adaptation to a lower level of energy use can take place within the existing structure of social institutions and values (and may indeed be the only way of preserving many such institutions and values in the long term) (cf. Leach 1979; Lovins 1975).

#### 8.4 Conclusion

There exists, then, a considerable degree of controversy over the extent to which the development of nuclear power produces safety, environmental, social and political implications which are cause for concern and which therefore prejudice the case for such development. A wide spectrum of positions exists from those proponents who see nuclear power as providing net benefits in these respects in relation to alternative energy production technologies, to those opponents who argue that it provides substantial net social costs which should not be contemplated. In combination with arguments about economic benefits it is evident that a complex matrix of stances on the nuclear power issue can be identified and the rather generalised treatment of the arguments which has here been necessary has obviously not been able to do full justice to this complexity. However, a basis is provided for proceeding to develop a categorisation of the debate and to an analysis of certain aspects of the cognitive and evaluative structures of the debate from the standpoint of the conceptual framework developed in the first part of this thesis.

## Chapter 9: Ideology, Rationality and the Nuclear Power Debate

### 9.1 Introduction: A Categorisation of the Nuclear Power Debate

Debates about public policy issues can be seen as debates about ends and about alternative ways of achieving them; in other words, they are arguably about the nature of the social values which are to be desired and about the kinds of social action that might be pursued in order to achieve them. Energy is an essential input to the process of creating 'value' (the material and immaterial 'goods' upon which value is placed in a particular social context). Consequently, debates about energy policy issues should be seen in the wider context of debates about social values and about ways of extracting useful energy from the natural environment and ways of using it to help create and sustain such values.

What are at issue, then, in debates about energy policy are not just questions of alternative means - questions concerning the implications of pursuing such means and the pros and cons in relation to the achievement of desired values. Rather, such values themselves are inherently contentious. In a social context of divergent value systems there are alternative sorts of values which could be achieved; however, not all such values can be achieved to the satisfaction of all groups due to problems of mutual exclusiveness and finite resources. Moreover, different means are variably suited to the achievement of different values so that means to the achievement of one set of values may have unavoidable implications which impede the achievement other values. Debates about energy policy are therefore necessarily debates about 'means-ends' complexes'; any discussion of means must imply consideration of the issue of desired values.

If there is a consensus between parties to an energy policy dispute on the nature of desired ends and values then debate can be effectively reduced to the consideration of alternative ways of achieving those ends. Two types of dispute arise in such a situation. Firstly, there is disagreement concerning the nature and extent of the implications of alternative means in relation to desired values; such disputes can be called 'cognitive disputes'. Secondly, there arise disputes about what the achievement of particular desired ends is worth in terms of detrimental effects in relation to other ends and values. This type of dispute can be termed an 'evaluative dispute' and can be further categorised as a 'bounded trade-off dispute'. It is 'bounded' in the sense that it takes place within the bounds of basic agreement on the nature of desired values, and it is about trade-offs of the benefits of a particular means in relation to certain desired values against its disbenefits in relation to other desired values.

However, if no consensus on the nature of desired ends and values can be negotiated between all the parties then debates about energy policy inevitably involve disputes concerning both ends and the means to their achievement. In such case a different form of evaluative dispute arises to essentially displace bounded trade-off disputes. This form can be termed an 'unbounded value dispute' since it concerns fundamental unbounded disagreement about the nature of desired ends and values. In the presence of this form of disagreement cognitive disputes can be expected to become rather more severe and complex because of effects on value-conditioned processes of knowledge formation. Trade-off disputes are displaced because of a fundamental lack of agreement on the values between which trade-offs are to be made. In order to be able to discuss trade-offs between two ends it has to be agreed that both can be assigned a positive valuation. If this cannot be agreed then the

benefits that one group sees for a particular course of action will not be recognised as such by another group and consequently no meaningful discussion can be pursued concerning the trade-off of such 'benefits' against 'disbenefits' which might arise in relation to other ends.

It is possible, then, to achieve some degree of categoriation of the debate about nuclear power in terms of the above discussion. The development of nuclear power programmes constitutes a means to the achievement of certain ends and values but the debate is as much about the relative desirability of the different ends for which nuclear power has implications as it is about the nature and magnitude of those implications. In other words the dispute has both 'cognitive' and 'evaluative' dimensions. In chapters 7 and 8 the distinction was made between the economic implications of nuclear power on the one hand and safety, environmental, social and political implications on the other; categorising the latter group broadly as 'social' implications gave us the two main types 'economic' and 'social'. Correspondingly, we can talk of 'economic' and 'social' ends and values, the former relating to such matters as, for example, the level of industrial costs, the growth of output of goods and services, the nature of economic rewards, the level and distribution of real income and so on, while the latter (i.e. 'social' ends) relate, for example, to the health and safety of the workforce and wider population, the protection of the environment, and to the issues of civil liberties and nuclear weapons proliferation.

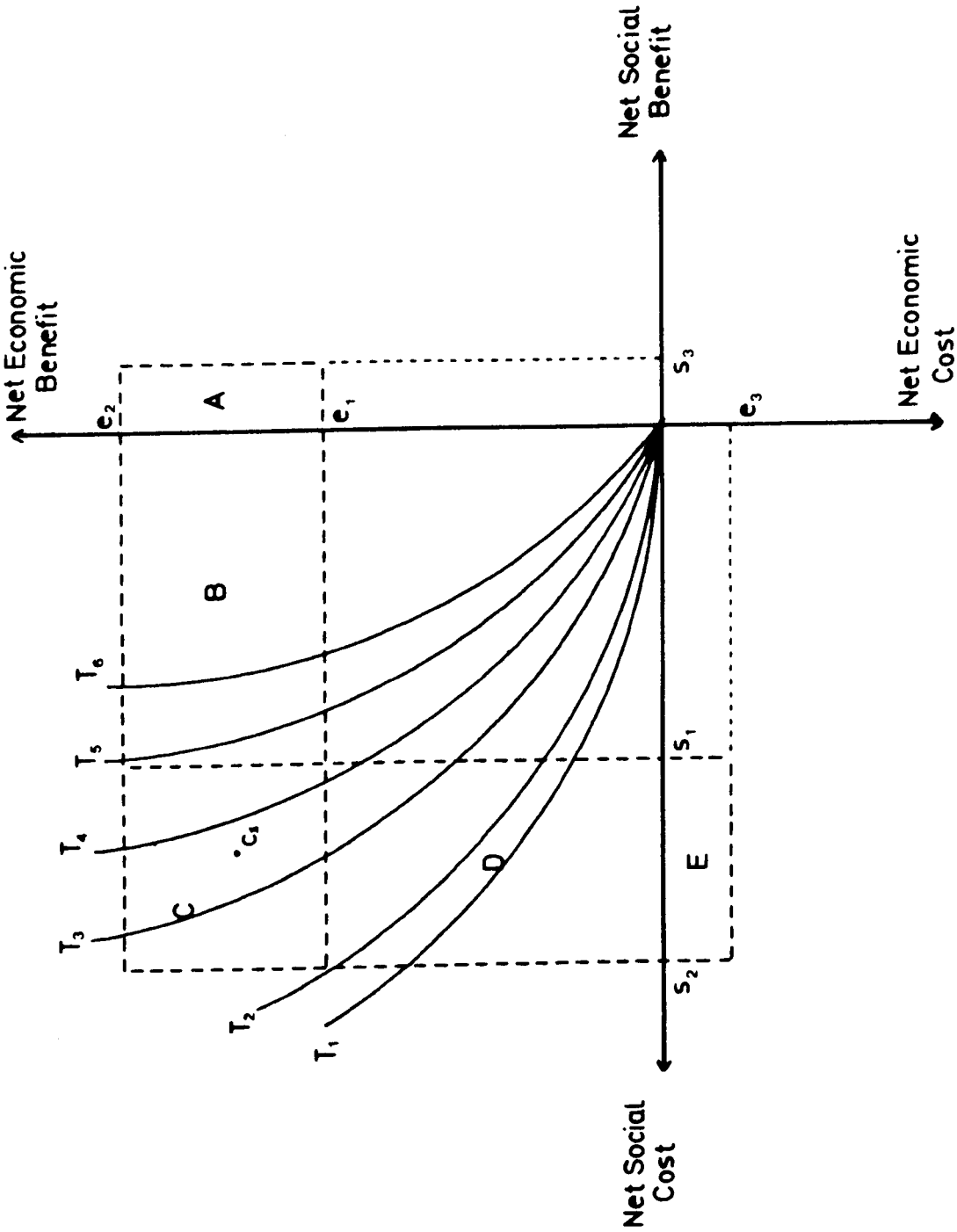
We can firstly analyse the debate in so far as it takes place within the framework of agreement concerning the nature of the ends and values which are desirable and worth achieving. It is indeed agreed by many parties to the debate that the reduction of energy costs and the promotion of material economic growth are desirable ends and that,



moreover, we should be concerned to protect workers and the public from radiation hazards, preserve environmental amenity, protect civil liberties, prevent the proliferation of nuclear weapons and so on. So, it is quite widely agreed that any contribution of nuclear power to the promotion of economic growth should be positively valued as a benefit while any problems it creates in relation to 'social' ends should be negatively valued as costs. Consequently, if the debate concerns the issue of whether to pursue a programme of construction of nuclear power stations as opposed to an alternative programme of investment (e.g. in coal-fired power stations) then we can schematically represent the possible stances in the debate with respect to two dimensions: firstly, the net economic costs and benefits and, secondly, the net 'social' costs and benefits - in both cases of the nuclear option compared to an alternative course of action. Figure 9.1 illustrates the resulting two-dimensional representation.

In this realm of the nuclear debate, then, the protagonists can agree on what constitutes a 'benefit' and what constitutes a 'cost'; this is a prerequisite for the application of a cost-benefit framework to be meaningful. Within such a scheme it is possible to examine the implications of the cognitive dimension of the dispute. Referring to Figure 9.1, supporters of nuclear power tend to argue for locations in this 'cost-benefit space' which represent substantial economic benefits to be derived from the substitution of higher cost fossil fuels in electricity generation and from the promotion of economic growth; in other words, supporters argue that nuclear power will provide an identifiable economic benefit of a magnitude that might lie, for example, between  $e_1$  and  $e_2$ . However, there is rather less agreement amongst supporters of nuclear power regarding the magnitude of 'social' costs and benefits. The strongest advocates tend to argue that nuclear

Figure 9.1 A Schematic Representation of the Nuclear Power Debate in a Cost-Benefit Framework.



power may actually provide some net benefits compared, for example, to coal-fired electricity generation, taking into account what are considered to be the relevant safety and environmental implications. This position is argued mainly by those associated with the nuclear industry (cf Jones 1980B, Hill 1981B, Greenhalgh 1980) and can be identified with locations in the area A. It is also broadly representative of the position presented by the CEGB in their case for the single PWR station at Sizewell (CEGB 1982A; Baker 1982). Other supporters recognise the existence of net disbenefits in relation to safety, environmental and political implications (eg up to magnitude  $S_1$ ) and therefore would argue for locations in, for example, area B (cf Weinberg 1978, 1980; Pearce 1980A; Pearce and Nash 1981).

The position of opponents of nuclear power in relation to this dimension of cognitive dispute (within a broad value consensus) can be seen as something of a mirror image of the position of supporters. These opponents tend to argue for locations which represent substantial disbenefits in terms of 'social' implications (eg between  $S_1$  and  $S_2$ ) but display rather greater disagreement concerning the economic implications of nuclear power programmes. The strongest opponents reject the argument that nuclear electricity generation will provide economic benefits in the form of lower cost electricity and greater economic growth, insisting that nuclear power will produce extra costs in all respects compared to alternative investments; they would therefore argue for locations in area E (cf Sweet 1982; Bunyard 1980, 1981; CSENE 1981). On the other hand, some critical stances do recognise and accept that nuclear power does provide economic benefits and would therefore argue for locations such as those in area D (cf Flowers 1976).

Therefore, the cognitive dimension of the dispute about nuclear power can be identified essentially as a dispute about claims concerning the

actual implications of developing nuclear power programmes for 'economic' and 'social' values. In the context of agreement about the desirability of such values, cognitive dispute will exist even if there is further consensus concerning the nature of 'appropriate' trade-offs between economic benefits and social costs. Referring again to Figure 9.1, for example, if supporters and opponents can further agree that T4 represents an appropriate trade-off function the dispute will nevertheless remain. Both groups will agree that points above and to the right of T4 represent outcomes for which nuclear power becomes acceptable (in terms of the economic benefits more than outweighing the social costs); however, opponents will argue that no such points exist (because the area DE defines all possible outcomes) whereas supporters will argue that the acceptance region contains all possible outcomes (cf area BA).

The existence of disagreement concerning the form of appropriate trade-offs between costs and benefits introduces the further evaluative dimension of dispute - 'bounded trade-off dispute' (ie bounded by underlying agreement on the nature of desirable values). The implications of this dimension of dispute can be illustrated by hypothesising an area C in Figure 9.1 which can be agreed upon by both supporters and opponents as containing all likely outcomes concerning the economic and social impacts of nuclear power. Now, disagreement over trade-offs results in several possible alternative trade-off functions being put forward by different groups of supporters and opponents. For example, if T2 represents the trade-off function of supporters and T5 that of opponents then, in spite of agreement on the cognitive level over the area C, the dispute will nevertheless remain; all of area C is above and to the right of T2 so all locations in it are acceptable to supporters, while, on the other hand, no locations in C are in the acceptance region defined by T5 for opponents. Similarly, even if the point C1 could be agreed upon as representing the most likely outcome, nuclear power

would be acceptable to a group with trade-off function T3 but unacceptable to those adhering to T4.

This analysis, albeit schematic and hypothetical, throws up an interesting implication. Within the framework of broad agreement about desired economic and social values, the dispute becomes increasingly complex and intractable in proportion to the extent to which cognitive and trade-off disputes become accentuated and interrelated. In particular, trade-off disputes involve the explicit consideration of the weighting of alternative values and this activity is (as indicated in earlier Chapters) conventionally seen as involving recourse to 'irrational' considerations. On the other hand, cognitive disputes are widely seen as involving matters of empirical fact and therefore as being rather easier to conduct on territory which is familiar to the disputants (eg in the categories 'true' and 'false'). Consequently, it would appear, in these terms, to be in the interests of those groups which have a strong commitment either for or against nuclear power to attempt to avoid the realm of evaluative trade-off dispute (which might be seen as containing the potential for the rapid erosion of credibility) and to attempt to restrict the dispute to the cognitive dimension where issues are translated into 'matters of fact' and therefore seen as more easily supported or refuted.

This can be illustrated by referring again to Figure 9.1. The implication is that parties to the debate would attempt to avoid arguing for outcomes which involve locations within the range of disagreement concerning trade-off functions ie within the area bounded by T1 and T6. Rather, supporters would attempt to argue that, as a matter of 'fact', nuclear power will provide substantial economic benefits and negligible social costs, or even some social benefits (cf area A) and that no 'reasonable' person could insist on a trade-off which would render this position unacceptable. Conversely, opponents would attempt to argue that

nuclear power will provide substantial social costs for a small (or non-existent) economic benefit (cf area E) and that the rational person must therefore reject it. We have indeed noted previously the affinity of parties to the debate for such positions.

Within the framework of consensus on desired economic and social values it is possible, then, to distinguish two basic categorisations of support for and opposition to nuclear power. On the one hand, 'unconditional' supporters and opponents are those who argue in the cognitive dimension for cost-benefit outcomes which would avoid the possibility of the acceptability or otherwise of nuclear power being dependent upon trade-offs which involve explicit reference to evaluative considerations. On the other hand, 'conditional' supporters and opponents adopt positions in the cognitive dimension which involve the question of acceptability being contingent upon trade-offs between values. Such 'conditional' positions are therefore open to reassessment and challenge to a greater degree than 'unconditional' positions given the dynamics of the dispute which involves continual interdependent change in our knowledge about the implications of nuclear power development and in peoples' valuations of the 'goods' which are affected by such development. Indeed, since the attempt to avoid an explicit evaluative dimension may be important in the establishment and maintenance of 'unconditional' positions, the question arises as to the extent to which adherents to such positions would be prepared to recognise the validity of changes in knowledge about implications and outcomes which would lead them to adopt a 'conditional' position. In such a question we come up against the problem of the interdependence of cognitive and evaluative processes in the determination of people's attitudes to such issues as nuclear power.

The debate about nuclear power does not, however, take place totally within the confines of agreement between groups concerning the nature of

desired ends. The opposition of some to the development of nuclear power is based upon the rejection of the values which prevail in our society and which are supported, actively or tacitly, by most groups. In this context there arises what can be called 'unbounded value dispute'. In the presence of this type of dispute it is not possible to conceptualise the debate in terms of a cost-benefit framework because such opponents will deny the existence of benefits; indeed, more fundamentally, they may deny the relevance of the concept of 'benefit' in the context of social, economic and technological development within the existing framework of institutions and values. For example, such opponents could agree that nuclear power may well promote economic growth but if they deny the desirability of such material growth they will see this as a disadvantage and as a reason for not pursuing nuclear power programmes. Therefore, such 'radical opponents' question the concept of economic benefits against which social costs can be offset (cf Commoner 1976; Lovins 1977; Mathews 1980). It is an interesting characteristic of arguments that tend to be propounded from such a radical standpoint that although the normal concept of benefits and the relevance of trade-off disputes are questioned, the emphasis is nevertheless often placed on presenting a cognitive position similar to that of 'unconditional opponents'; for example, Commoner and Lovins (op cit) argue for outcomes involving substantial social costs but also place considerable emphasis on attempting to refute the argument that nuclear power will promote economic growth. This may be due to a recognition that to have an impact on the debate their arguments must be capable of 'translation' into the context of an accepted framework of values.

The above scheme, then, provides a framework for the categorisation and analysis of the debate about nuclear power. It emphasises the two major dimensions to the debate: the 'cognitive dimension' concerning the nature of the implications of a nuclear power programme in economic, environmental,

social and political terms; and the 'evaluative dimension' concerning the perceived desirability of such implications. This distinction is broadly consistent with Fishbein's attitude formation model as employed, for example, by Otway, Maurer and Thomas (1978), which conceives of attitudes (A) in terms of a function of beliefs (b) that an object (o) is characterised by a particular attribute (i), and of evaluations (e) about the desirability of the attribute. Therefore, for a set  $n$  of relevant beliefs:

$$A_o = \sum_{i=1}^n b_i e_i$$

The work of Otway et al (ibid) has illustrated the importance, in the controversy over nuclear power, of the cognitive dimension - of differences in beliefs about the nature and magnitude of the costs and benefits associated with its development. Nevertheless, the emphasis is placed, in explaining public attitudes, on the evaluative dimension indicating the importance of concerns relating to the social and political institutions implied by nuclear power and to the underlying 'social and moral order' of different groups (ibid p 115-7; Cotgrove 1981 p 132-6). Hence the argument that 'the nuclear debate is about values'. However, it can be argued that such a perspective tends to neglect the significance and implications of dispute in the cognitive dimension, perceiving this aspect of the problem in terms of the acceptance or non-acceptance of 'factual information', thus implying the separateness of the cognitive and evaluative realms (Otway et al 1978 p 116). It leads to the view, implicit, for example, in the argument of Bickerstaffe and Pearce (1980), that we can make progress towards consensus on the basis of information about the impact of nuclear power in relation to social goals (ie about social costs and benefits) considered separately from issues relating to the definition and weighting of those goals.



Underlying much of the discussion and debate about nuclear power, then, is a particular conception of scientific knowledge and information. Two major broad positions are discernible as indicated above. On the one hand, there are those who argue that the issue is clear-cut and that the facts speak for themselves indicating that the cost-benefit outcomes are such as to generate no question of dispute over evaluative trade-offs (cf 'unconditional' positions). On the other hand, there are those who argue that the facts concerning cost-benefit outcomes are such that the question of acceptability is contingent upon evaluative trade-offs and that the conduct of the debate must take on board the importance of the latter dimension (cf 'conditional' positions). Both these positions are based upon the assumption that it is possible to identify through scientific investigation a set of 'reliable facts' about the likely implications of nuclear power programmes which all participants should be able to agree upon if they behave in a reasonable and rational way (eg critically evaluate all the available information). The existence of disagreement in the cognitive dimension is therefore explained in terms of the adherence by certain groups to positions based upon factual evidence which is wrong and therefore is capable of empirical refutation.

However, the implication of the analysis presented in Part One (Chapters 2-3) is that this perspective on the relationship between the cognitive and evaluative dimensions of the nuclear power debate cannot be upheld and that a proper understanding of the role of the cognitive dimension in the debate requires a rather different conception of the nature of the scientific knowledge which can be derived about the implications of nuclear power programmes and the role of such knowledge in debates about public policy issues. Such a conception has been outlined (cf Chapters 4-6) and the concern of the remainder of this Chapter will be to examine certain aspects of the nuclear power debate as conducted in this country in order to illustrate some of the analytical implications of this concep-

Firstly, however, it is perhaps worth very briefly summarising the major characteristics of this conception. It is argued that social scientific knowledge must be seen as thoroughly contingent upon values whose meaning is established in an interpretive way in relation to the prevailing social, institutional and political context. Therefore, social knowledge is necessarily morally tinted; any attempt to portray such value-conditioned knowledge as 'objective' and 'value-free' must be seen as ideological. The development of social knowledge is not an isolated mental activity but is rooted in human social activity. Such knowledge is seen as arising from the continuous need to confront and solve problems concerning human relationships which are perceived from particular social perspectives. In a structured social context different values and interests define different 'locations' and perspectives and different 'world views' can be seen as arising within such 'locations'.

It is argued that amongst these various perspectives particular interpretations of the meaning of the social world and its problems condition the process of knowledge development. Thus, in a structured context dominant 'universes of reality and value' arise which define relevant and significant problems and therefore condition what is accepted as viable and relevant knowledge. Such knowledge is then in turn reinforced by the problem-solving process. This process is seen as comprising both 'cognitive-rational' and 'normative-legitimatory' components and social knowledge is seen as playing an important role in providing interpretations of social meaning which serve to legitimise institutional structures and therefore to aid in the maintenance and transmission of social order and stability.

In relation to this wider problematic of the maintenance of social stability and control the process of development of social knowledge is seen as closely tied up with the institution of the state. The state is

seen as primarily concerned to ensure social stability through the promotion of the conditions for capital accumulation, through the maintenance of institutions of social control, and through maintaining mass loyalty by securing the conditions for hegemony of a particular 'universe of reality and value' which provides dominant interpretations of the meaning of the social world and therefore serves to legitimise its institutional structure. It is argued that the increasing involvement of the State in the social and production systems has produced the need for rational-formal procedures of planning and allocation. Moreover, difficulties in achieving the conditions for social control and stability have placed increasing strains on legitimising frameworks and created a need for their reinforcement. Therefore, it is argued that the development of social knowledge has become increasingly related to the requirements of the State in respect of problem-solving and legitimation and that this has resulted in a dominant body of ideological knowledge which both asserts the possibility of objective, value-free knowledge and contains a conception of its application to the guidance of social action.

The main theme of this dominant ideology, then, is a technocratic form of rationality which relates the nature and form of knowledge to its utilization in the direction of social and political action. A positivistic conception of knowledge development provides a model of valid neutral scientific reason and various bodies of theoretical knowledge provide the relevant 'facts' which are to guide action. Technocratic rationality embodies a form of instrumental reasoning which confines the concept of rationality to the process of considering alternative means to given ends on the basis of objective, value-free knowledge; ends become relegated to the realm of the subjective and 'irrational' and 'progress' becomes equated with the replacement of the 'irrational' political process by rational technocratic guidance on the basis of value-free science. It is argued that further themes of this dominant ideology are a 'liberalist'

conception of the free, individualistic, harmonious equilibrium society and a 'materialist ethic' which equates social welfare with the quantitative output of material goods and services.

It is now possible to analyse certain aspects of the debate about nuclear power from the perspective of this conception.

## 9.2 Technocratic Rationality and the Nuclear Power Debate

The aim of this section is to indicate the extent to which the themes of technocratic rationality are manifested in the arguments which are widely propounded in support of the development of nuclear power. We are concerned here with the perspective which sees nuclear power simply as a means to the achievement of given ends and the debate about nuclear power as a purely 'technical' construct in which only issues related to the choice of means are susceptible to 'rational' consideration involving the application of scientific reason. This functional or instrumental concept of rationality results, then, in an elevation of such scientific reason and expertise to a position of unchallenged authority in the debate as the fundamental prerequisite for 'rational' decisions. Improved decision-making and debate is therefore seen as contingent upon the improvement of our objective, factual knowledge about the implications of nuclear power, upon the establishment of a greater role for the experts who have command over such knowledge, upon the dissemination of such knowledge to eliminate ignorance, and upon the willingness of all parties to abandon irrational, emotional responses and base their positions on the 'facts'. These themes can be developed somewhat with reference to examples.

Firstly, then, there is a tendency to view the nuclear power issue in purely technical terms. For example, Sir John Hill (1981A p516) has

referred to the outlook of the nuclear industry in the early years of development and describes the nature of the problems that were considered to be relevant:

"Of course we foresaw that there would be problems but we imagined that they would be amenable to solution by Science and engineering. In particular we imagined plants getting bigger and more efficient as our technology and engineering improved and we saw the real struggle as an economic one - to generate electricity more cheaply than by burning fossil fuels." (ibid)

In other areas relevant problems were technical in nature concerning the means to given ends and were susceptible to solution on the basis of science, the process resulting in technological progress. The view of the nuclear power debate as involving only technical issues is also illustrated in the argument of Fainberg (1980 p44):

"But why is it that in the nuclear power debate, issues which appear to be technical in nature, and thus amenable to rational scientific analysis, are the source not only of confusion, but also of invective and irrationality? In principle, reasoned debate is the best way to deal productively with such matters, and I respectfully suggest it is particularly necessary now to turn to this mode of discussion."

Therefore, the nuclear power debate is seen as simply about the application of objective, factual scientific knowledge in the determination of the acceptability of nuclear power as a means of producing electricity. As far as many supporters are concerned the relevant facts provide an irrefutable case for nuclear power so anyone who opposes nuclear power is behaving 'irrationally' in ignoring scientific evidence and basing decisions on 'emotional' factors. The problem, according to, for example, Fells (1981, 1982), Fainberg (op cit) and Hill (1978, 1981A, 1981B), is ignorance compounded by emotionality. Fainberg (ibid p44) argues that the complexity of the issues means that even experts in particular fields cannot command sufficient knowledge to understand all the issues:

"The road from this situation to irrational and emotional argument is thus quite well laid out." (ibid)

Further, the linking of nuclear power with nuclear weapons is seen as evoking a ... "deep emotional response" ... (Fells 1982 p81), and this is seen as compounding problems deriving from ignorance of the facts about the risk of accidents and the hazards of radiation. The situation is exacerbated by the media who propagate ... "misleading and untrue statements" ... (Fells 1981 p223).

This general perspective on the nature of oppositional positions with respect to nuclear power is illustrated in the arguments put forward by Döderlin (1976). He focusses on the ... "mysticism, irrationalism and emotionalism" ... which he sees as providing an important basis for attacks on nuclear power, a technology which, he argues, is on the contrary ... "the antithesis of irrationalism". He suggests that the dominant problem in the nuclear debate may be that of ... "fighting emotionalism and irrationalism" ... as an approach to the analysis of the major problems of our ... "real, physical world". He identifies 'emotionalist' critics of nuclear power in terms of groups ... "playing out their inner and emotional needs" ... and groups ... "furthering their own political goals" ... the latter composed of professional and 'amateur' politicians, notably leftist groups, anarchists, some populists and some environmentalists. He criticises them in the following terms:

"They rarely support their assertions with reasoned arguments or with facts, and they consistently invoke the opinions of some distinguished scientists, some Nobel prize-winners or some professional societies, ignoring others who disagree with their views. By confusing technical facts which can never be argued qualitatively, with value-judgements which can always be argued, the critics have in some countries succeeded in misleading sections of the public, causing them to believe that everything is open to argument and that the experts are confused. The truth is that the experts are not confused in their own field of expertise. Outside their own field they are not experts." (ibid p202).

Underlying this position, then, is the view that 'rationality' resides in the assessment of means in relation to objective, value-free scientific knowledge and that by adhering to such a standard of rationality the case for nuclear power can be made in an uncontestable manner. The converse of this position is the view that questions relating to ends and values cannot be discussed within the bounds of 'rationality' and therefore necessarily involve recourse to the realms of 'irrationality' and 'emotionalism'. An example of this view is provided by Brookes (1976 p2) with reference to those groups who question the desirability of continuation of the present trajectory of economic and technological 'progress':

"One can understand and to some extent sympathise with the prevalent, near-puritanical reaction to the rapid technology-based economic growth of the post-war world. But to see the reason for it and to sympathise with the attitudes behind it, is not the same thing as agreeing that it is a rational and sound reaction. It is on the contrary a largely irrational reaction stemming from deep emotional conviction rather than any dispassionate analysis of the problems and the practical options for dealing with them. Even though the movement has now attracted a great deal of organised thought and is backed up by intellectual analysis that is often of very high quality it still relies for its wider support on attitudes that are largely emotional and irrational. Such attitudes - even though they may do credit to the holders of them - are no basis for tackling the problems that face the world in the last quarter of the twentieth century."

In other words, since debates about ends and values can only be conducted in terms and categories which are not susceptible to rational analysis, they can play no part in the process of formulating policy in relation to nuclear power, or any other technological developments; our problems can only be solved if we leave such considerations aside and focus on factual evidence concerning the relative merits of alternative means to given ends.

An important implication of this perspective is that it produces a tendency to regard the motives of opponents of nuclear power with some degree of suspicion. Thus, if it is believed that there exist unambiguous 'facts'

about the implications of nuclear power, that the debate could be resolved if all parties behaved rationally and recognised these facts and listened to the experts, and that opponents are introducing irrelevant, irrational and emotional considerations to cloud the issue, then questions naturally arise concerning motivation: why should people behave so irrationally if it were not for some ulterior motive? Therefore, we find charges against opponents of being obstructive and irresponsible, using 'shock horror' tactics to cause public concern (cf Hill 1981B p3), deliberately 'distorting' the evidence (ibid p3-4) and deliberately employing emotion as an instrument to cloud the debate (Hill 1978 p17). To refer to a rather extreme example, in her evidence to the Sizewell B Public Inquiry (Transcript Day 51) Dr K Little frequently refers to 'propaganda' disseminated by anti-nuclear groups, accuses them of deliberately obstructing the debate and alleges connections with, for example, 'communists' and South African terrorist organisations. The allegations of Hoyle (1977) concerning links between anti-nuclear groups and the USSR are well-known. Such allegations as these are indicative of the existence of the problem of fundamental incommensurability between the perspectives of such supporters and opponents in respect of the very definition of what is 'rational' behaviour.

It is widely argued, then, by supporters of nuclear power that these problems of ignorance, emotionalism and obstructivism constitute a serious obstacle to efficient decision-making. Fells (1981 p222-3) argues that the decision-making process is ... "frustrated and unreasonably protracted"... due to public apprehension and the influence of pressure groups. Hill (1981A p519) argues as follows:

"The fact that public perceptions of the safety of many things in our society, and nuclear power in particular, differ so widely from the understanding of those who have spent their lives studying the subject is a matter of concern. It makes for great inefficiency in the way we conduct our affairs and this in turn damages the well-being of the society the industry is attempting to serve."



The implication is, of course, that the efficiency with which we conduct our affairs will be increased to the extent that we reduce the influence on the decision-making process of the forces of 'ignorance' and 'emotion' and enhance the influence of the factual evidence as dispensed by the experts.

Indeed, such recommendations, implicit and explicit, are to be found in the arguments of supporters of nuclear power. In this context, something of an 'ideal' is outlined by Sir John Hill (1981A p517) as follows:

"Nuclear power started in the days before protesting had become an established occupation. It started at a time when the public had great respect for science and technology, which they saw as the answer to shortages, cold and want. The public trusted scientists and technologists, and there was much less public criticism of the management of our societies. Many of the older industries had a very poor safety record and the perceived hazards of nuclear plants was minimal. The technologists had great freedom to build and operate plants in the way they thought right without external constraints. Decisions could be taken quickly and progress was extraordinarily rapid."

It is widely argued that the emphasis must now be on restoring 'objectivity and realism' to the debate, on replacing 'uninformed emotional response' with a 'balanced critical approach' and on ensuring that decisions are based on 'facts and reason' rather than on 'oratory and emotion' (cf Fells 1981 p223-4, 1982 p82; Hill 1978 p18; Steward 1982 p29). More specifically, it is argued that it is necessary to educate the public and politicians to understand the facts about nuclear power to eliminate opposition based upon emotion and intransigence (Fells op cit; Weinberg 1978 p74). It is seen as desirable that discussions and decisions about nuclear power are based firmly upon reliable factual knowledge and that this will involve the employment, as much as possible, of formal, quantitative knowledge. For example, Håfele (1974 p321) argues the need for ... "a high level of formalisation"... of the debate and Döderlin (op cit p203) suggests that...

"...an evaluation of rational and quantifiable factors tells us how many lives, which environmental improvements and what economic advantages we have to sacrifice in order to satisfy... emotional demand... (As) many problems as possible should be decided on a reasoned, factual and rational basis."

A final element in this argument concerns the role in the debate and the decision-making process of experts with command of the relevant scientific information. Again, Döderlin (ibid) provides an illustration of the position:

"If one expects the public to have confidence in the role of professionals in decisions, the opinions of highly regarded experts within their chosen profession must be accorded a certain authority."

Therefore, this conception of 'efficiency' in decision-making as propounded in the arguments of supporters of nuclear power provides an example technocratic rationality in practice. A further specific illustration can be briefly referred to and this relates to reactions by certain supporters of nuclear power to the Windscale Inquiry. On the one hand Tombs (1978 p6) supports the emphasis in the Inquiry on empirical factual information:

"I especially welcome Mr Justice Parker's emphasis on numerical and factual support for the arguments put forward. By such means emotional arguments can be reduced to an objective and intelligent level."

On the other hand, however, Greenhalgh (1980 p224) questions the legitimacy of the participation of certain organisations which opposed THORP with reference to its wider political and social implications:

"It was remarkable that Durham County Council, The Town and Country Planning Association, the National Council for Civil Liberties and the British Council of Churches... took an active part in opposing the Windscale reprocessing plant... Yet these are bodies whose responsibilities would normally appear to be quite remote from Windscale, from matters of energy policy and from the wider issues of public health and safety."

These arguments illustrate two basic features of technocratic rationality: firstly, the emphasis on objective facts as a basis upon which to derive efficient decisions about means to given ends; and, secondly, the view that the debate should be limited to certain 'technical' considerations and that the introduction of other considerations, especially those related to wider social ends and values, merely clouds the issue with reference to emotional and irrational tendencies.

On the basis of the above analysis of the manifestations of technocratic rationality in arguments supporting the development of nuclear power it is possible to identify certain implications for the conduct of the debate which can be subjected to further critical analysis. Firstly, as already indicated, the restriction of the concept of rationality to the realm of 'technical' question concerning the merits of alternative means in relation to given ends means that the 'practical' discussion of alternative ends is relegated to the realm of the 'irrational' and therefore has no place in an 'efficient' decision-making process.

Consequently, efficiency in decision-making implies the hypostatization of particular ends and values; in the name of efficiency and value-freedom, then, the debate about nuclear power must be conducted within a given framework of existing dominant values and ends. Attempts to question such values take one, by definition, outside the confines of rational debate. It is therefore important to explicitly establish the nature of such ends and values and to assess what implications they have for the conduct of the debate.

One important such implication concerns the definition of the range of relevant means for particular given ends and values. If certain ends become hypostatized then the consideration of alternative means is circumscribed to the extent that certain means can be expected to be

more appropriate than others to the achievement of the ends and values concerned. The position taken here is that the appropriateness of means cannot be established purely by the 'rational' process defined by technocratic rationality but rather must inevitably make reference to the realm of values designated as 'irrational'. Any 'rationality' which can be established within the framework of technocratic rationality can only be defined within limits set by value considerations and therefore is contingent upon such considerations. Moreover, the situation is further complicated because, as I have already argued at some length, technocratic rationality embodies a conception of objective social knowledge which cannot be realised so it cannot provide a meaningful conception of rational and efficient debate and decision-making.

A further implication concerns the approach to the question of evaluation of perceived costs and benefits in relation to goals and objectives. Within the framework of technocratic rationality such a question is irrational to the extent that it involves discussions about values and the implication is that 'evaluative trade-off disputes' are to be avoided if the decision-making process is to be rational and efficient. The question is, then, how are such questions to be handled if this imperative is to be adhered to?

These implications will be examined in more detail in the following sections. The next section analyses the nature of the dominant ends which energy policies are concerned to achieve; and Section 9.4 takes up the question of the rationality of the consideration of means (nuclear power and alternatives) in terms of both the analysis of implications and their evaluation.

### 9.3 The Energy Problem and the Nuclear Solution

#### 9.3.1 Introduction

An examination of the way in which the 'energy problem' is perceived and defined according to the conventional wisdom in our society is important for three main reasons. Firstly, within the analytical framework which I have developed, the process of knowledge formation is heavily conditioned by the requirement to solve perceived social problems; therefore, we would expect an analysis of the perceived energy problem to provide insights into the nature of knowledge about the energy system. Secondly, through such an analysis it is possible to move towards a better appreciation of the nature of the ends and values which condition the wider problem-solving process; thus, the definition of the energy problem must be based upon certain value-premises, and ends can be seen to be equated with the solution of the problem-as-defined and, consequently, the achievement of the values which are implied in its definition. Thirdly, since the perception of the problem conditions the form of action which is seen as appropriate in the attempt to achieve a solution, an understanding of the nature of the perception will promote a better appreciation of the process of the consideration of alternative means to the solution of the problem.

Fundamental to the analysis of social problems, from our perspective, is the recognition that they mean different things to different people. The problem of different perceptions and interpretations of the energy problem is identified, for example, by Lovins (1977 p12):

"Underlying much of the energy debate is a tacit, implicit divergence about what the energy problem 'really' is. Public discourse suffers because our society has mechanisms only for resolving conflicting interests, not conflicting views of reality, so we seldom notice that those perceptions differ markedly."

More specifically, Caldwell (1976 p32) argues that different interpretations of the nature of the energy problem can be related to different social interests:

"Interpretations of the problem... are influenced by the societal arrangements through which energy is employed and administered... (and)... the personal interests of the people administering the institutions primarily concerned with energy policies may not be consistent with an accurate interpretation of the problem or with its fundamental solution." (ibid)

This argument, however, raises the important issue of the extent to which it is possible to talk about 'accurate' interpretations and 'fundamental' solutions. If it is accepted that the definition of the problem is in some way contingent upon social interests and values then to posit an 'accurate' definition is to posit the possibility of deriving objectively true statements about the social world as distinct from ideological statements. If, as I have argued, this is not a tenable position then we must accept the implication that such alternative value-contingent interpretations of the energy problem must be analysed not in terms of their accuracy or inaccuracy but rather in terms of the social values and ends whose achievement is implied by attempts to solve the problem-as-defined.

The perception of the energy problem, then, can be seen as tied into a wider framework within which an approach is made to the broader question of the planning of the future course of social development. In this context it is appropriate to refer to the work of Lindberg (1975, 1976) concerned with the analysis of the way in which dominant elites in capitalist societies perceive and solve social problems. Lindberg compares 'routine' policy formulation to Kuhn's concept of 'normal Science' (cf above Chapter 2) in that both are seen to rest upon a prevailing 'paradigm', ... "a distinctive set of appreciations, rules, standards and

models of reality." (op cit 1976 p266). His analysis is concerned to establish the extent to which a dominant policy paradigm underlies policy formulation in capitalist societies providing 'fundamental criteria' for developing, debating and selecting options for policy action (ibid p266-7). More specifically, he defines policy paradigms as...

"..."schema' or 'pre-existing assumptions about the way the world is organized', that structure information, help make sense of complex environments, define what will be paid attention to, considered problematic, and what actions or responses are both available and appropriate." (ibid p273).

Moreover, Lindberg sees such policy paradigms as closely related to interests and values as defined in a particular social context:

"There is reason to suppose that such policy paradigms derive not only from the historical experience of particular polities, but more importantly, from the general terms of economic and political organisation and of ideological hegemony in a society. Policy paradigms, then, not only guide and rationalise the decision process; they may also reflect and seek to justify and perpetuate the power resources and relationships of the dominant groups in society." (op cit 1975 pXIV).

Lindberg's approach emphasises that the process of problem perception and definition takes place within a wider framework of world views, normative standards and operational rules and must therefore be related to dominant structures of ideological knowledge and to the normative basis of those structures. The present analysis, then, will attempt to identify the normative commitment implied in the interpretation of the energy problem to be found in the 'dominant energy policy paradigm' in our society. I shall firstly briefly review the 'official' perspective on the energy problem as manifested in various government statements and then analyse the nature of the problem as it is presented in the arguments of various supporters of the development of nuclear power. Finally, I shall draw some conclusions on the implications of the analysis.

### 9.3.2 The 'Official' View of the Energy Problem

Several observers in recent years have directed attention to the extent to which the conventional, official perspective on the energy problem is preoccupied with considerations of energy supply (cf Lovins 1977, 1979B; Lindberg 1977; Patterson 1977; Avebury 1978). An early illustration of this perspective is provided by the 1967 Fuel Policy White Paper (Ministry of Power 1967) which was concerned to...

"...re-assess the balance between the available primary fuels (coal, oil, nuclear power and natural gas), and to set the framework for the more beneficial development of our energy supplies." (ibid p1).

The Government's concern was, therefore, ..."to see that our growing energy requirements are supplied in the way which yields the greatest benefit to the country"... (ibid p2). The primary resulting objectives of fuel policy were adequacy and security of supplies, and the provision of 'cheap energy' subject to consideration of the implications for the balance of payments and for the efficient use of resources (ibid p35-9).

This rather narrow preoccupation with questions of energy supply was subjected to the test of the 1973/74 oil crisis. The result was a tendency for the perspective to be galvanised somewhat with the emphasis changing from the problematic of coordinating supplies of relatively cheap energy to fuel economic growth (as in the 1967 White Paper) to that of ensuring supplies of energy at reasonable cost to guarantee growth prospects. On the other hand, the massive increases in oil prices and temporary shortages during 1973/74 did cause the perspective to be tempered somewhat by considerations of efficiency of use and waste. A summary of the general perspective and priorities of the newly-formed Department of Energy after the events of 1973/74 is provided by its first Secretary of State:



"Consumption of energy on a large scale is part of the fabric of our society... we have to plan far ahead to continue to meet these needs as securely, flexibly and cheaply as possible in a way which allows continuing economic growth. But whereas our consumption patterns reflect past access to cheap and plentiful supplies of energy, we must now accept that energy is an expensive commodity; that more active policies are needed nationally and internationally to achieve security and availability; and that much more attention needs to be paid to the way we use our energy, cutting out waste and improving efficiency." (Varley 1974 p697).

This basic perspective was carried forward into the Green Paper on Energy Policy published in 1978 (Department of Energy 1978 p1):

"Our standard of living and well-being depend on adequate supplies of energy. So, too, do the hopes of the developed world. We have become accustomed to oil and natural gas being available in plenty to power the world's economic growth. The future is very uncertain, but there is now wide agreement that world oil supplies cannot continue to increase for much more than a decade or so and will, thereafter, become increasingly scarce and expensive. This poses a serious and complex problem. The world as a whole will need to turn to other sources of energy, and so, despite our present relative affluence in energy, will the UK."

The objectives for energy policy discussed in the Green Paper relate primarily to the supply and cost of energy although, again, reference is made to the need to use energy more efficiently within the existing economic framework. Underlying this perspective on the energy problem, then, is a basically materialistic value orientation: the overriding concern is to ensure that energy is supplied in sufficient quantity and at such a price that the growth of output of material goods and services (the central measure of welfare) can continue without constraint. In the 1978 Green Paper the then Secretary of State for Energy, Tony Benn, did make an attempt to introduce other values by referring to 'perceived problems' relating, for example, to fuel poverty and the freedom of consumer choice between fuels. However, such values have not made any impact on the process of energy policy formulation as more recent government statements indicate.

Shortly after the election of the Conservative Government in 1979 the 'traditional' perspective was reaffirmed through a statement of the objectives of energy policy as follows:

"The objective of energy policy has, traditionally, been to ensure the adequacy, security and efficient use of energy supplies, at the lowest practical cost to the nation in terms of real resources after paying due regard to safety and environmental considerations; adequacy has meant that energy supplies should not be a constraint on economic growth." (Secretary of State for Energy 1981 p1).

Values related to the protection of people's safety and environmental amenity are given an implied subsidiary role here while the major emphasis remains on material economic growth. Again, in the 1981 White Paper on Nuclear Power it was argued that:

"The Government has a duty to ensure as far as possible that both now and in the future Britain has available at a competitive and economic price secure supplies of energy sufficient to sustain economic activity, to accommodate growth, and to provide for our people's personal welfare." (Department of Energy 1981 para 1.02).

Here, the 'provision of personal welfare' appears to be something of a 'safety net' for non-material considerations but stated in such a vague manner it is questionable the extent to which such values can have an influence on energy policy formulation. Indeed, more recent statements of the Government's perspective make no reference to any welfare considerations outside the framework of 'economic efficiency'. For example, in the statement of the Government's approach to energy policy provided by the Department of Energy's Proof of Evidence to the Sizewell B Public Inquiry (Department of Energy 1982) social value is implicitly equated directly with the competitive and efficient operation of the economy under the influence of free market forces:

"A major aim of the Government's overall economic policy is to set the right conditions to enable the supply side of the economy to

operate more competitively and efficiently. A crucial element of that policy is to remove, where practicable, obstacles to the free operation of market forces throughout the economy... . The thrust of Government policy in... (the energy)... sector therefore is to remove market distortions where possible or otherwise seek to ensure that the energy market operates as nearly as possible as a free market. Such an energy market will regulate energy supply and demand with greater success and efficiency than relying on central planning as the means of ensuring that UK supply meets demand." (ibid para 2).

From this perspective, then, the energy problem is basically seen to consist in the existence of impediments to the operation of the free market forces which will ensure the efficient function of energy markets and consequently ensure that supplies are available to meet the demand which arises. The two central elements of energy policy are therefore seen to be the removal of such impediments and measures to ensure that energy prices reflect 'market pressures'. Energy demand is seen to arise from the free and rational decisions of millions of consumers in relation to such 'realistic' prices and the thrust of policy must be concerned to ensure that secure supplies are available at the lowest possible cost (ibid paras 2-15).

Two normative themes can therefore be seen to underlie this perspective. Firstly, a 'materialist' theme implicitly equates social welfare with the expansion of output of goods and services (for example, as traditionally measured by Gross National Product) and relegates other values to subsidiary status. For example, considerations relating to the environment have gained mention but are not given much weight, especially in recent statements. Further, it is interesting to note what has happened to the value considerations which Tony Benn tried to introduce into the process of energy policy formulation in the 1978 Green Paper. At the Sizewell B Public Inquiry the Department of Energy's chief witness was asked, under cross-examination, about considerations of 'fuel poverty' and 'domestic comfort'. Mr Priddle's reply is illuminating:

"Work on the social implications of fuel poverty is primarily a matter for the Social Departments in Government. The Department of Energy's responsibility is to ensure, so far as it can, that energy is produced and supplied economically and efficiently. If there are social problems arising from the hard economics of supply of energy, then the lead responsibility for that lies with other departments." (Sizewell B Public Inquiry, Transcripts Day 40 p23).

On domestic comfort again his reply was:

"I think you are again touching on an area of social policy rather than energy policy. It is very important to try and keep these two things separate." (ibid p24).

Consequently, certain values are being 'written out' of the energy policy-making process giving the process its heavily materialistic normative underpinning and also reflecting the theme of 'rationalism' to the extent that such fragmentation of values reduces the scope for the political activity of integrating and trading off value achievements, thus enhancing the 'technical' nature of the policy-making process.

Moreover, this official perspective on the energy problem and policy objectives can also be seen as underpinned by the value judgements inherent in the 'liberalist' view of society which posits the existence of a social optimum defined in terms of a social, economic and political equilibrium which is achieved through the social mechanisms of market exchange and democracy which in turn are 'driven' by the autonomous preferences of free, rationally-behaving individuals maximising their self-interest in a process of equal exchange in the market. Based on this model of society arises the fundamental value judgement that the individual's preferences as revealed in the market should count and that decisions which reflect such preferences are good decisions. Such a normative theme has been implied to a greater or lesser extent in official statements over time, perhaps becoming rather less influential during the 1970s with the attempts by the Labour Administration to modify the normative basis

of energy policy formulation. However, more recent government statements certainly indicate a resurgence on this theme as an important normative basis for energy policy formulation.

Having briefly examined 'official' perspectives on the energy problem we can now proceed to an analysis of the forms in which the problem is perceived and interpreted in the arguments of supporters of the development of nuclear power.

### 9.3.3 Pro-Nuclear Perspectives on the Energy Problem

Some observers have referred to the underlying value orientation of advanced industrial societies towards the continued expansion of material economic outputs as a 'growth imperative' (cf Habermas 1976B p370; Caldwell and Woolley 1976 p116). Lindberg (1977 p347) argues that such an imperative is manifested in ... "a common commitment to national power and resource and capital-intensive economic growth measured in GNP terms." This theme is very much in evidence in the interpretation of the energy problem presented by supporters of nuclear power. The following quotation from R.J. Weeks, the Director-General of the N.E. Region of the CEGB, perhaps epitomises the viewpoint:

"The world's population is increasing and so, quite properly, are people's expectations. Third World countries need a greater share of the energy cake, and that means fossil fuels for the most part. Resources of oil and gas are limited, and there will be pressure on coal, not only as a fuel but as an oil and gas substitute and as a raw material. Contrary to what is sometimes claimed, this picture will not be greatly altered if conservation measures are, as they need to be, successful - on a world scale you cannot conserve what you haven't already got. The clock cannot be stopped or put back and some kind of dirigiste low-energy scenario will not be accepted by the developing countries in order to satisfy the continuing appetites of the advanced economics. At best, a scramble for world energy will make for economic instabilities, and at worst, for widespread social disturbance and conflict. It is naive to pretend that we in the UK, with our open economy, will somehow be untouched by these events." (Weeks 1982 p13).

The various elements of this broad perspective can be examined in rather more detail. Firstly, there is, once again, a definition of the concepts of 'social welfare and progress' in terms of material economic growth and technological progress (cf Greenhalgh 1980 p3; Hill 1981B p3). This pattern of growth is seen as desirable not only in advanced industrial societies but also for Third World developing countries; it is assumed that what is good for the former must also be good for the latter and that developing countries will, as a matter of course, model their development on western industrial societies (cf Greenhalgh op cit p3-18; Brookes 1976 p5). However, there is a tendency to translate such normative themes from values which are to be desired into imperatives which must be achieved. This is done, firstly, by arguing that an orientation towards the achievement of such values will inevitably continue; as Sir John Hill has argued:

"...does anybody really believe that England, still a comparatively wealthy country, is not going to try and raise its standards of living?... Does anybody believe that the poor countries are not going to try and raise their standard of living? Of course not and the result will be that world demand for energy will continue to rise at least for the next 30 years." (Hill 1976 p3).

The second part of the translation is achieved by arguing that failure to continue in the pursuit of material economic growth would produce necessary consequences that cannot be contemplated, since they would involve no less than the breakdown of the fabric of our society.

Greenhalgh (op cit p3) quotes Wilfred Beckerman as follows:

"Only an altogether unparalleled optimism can lead one to believe that the vast mass of the population will voluntarily accept an abandonment of the goal of economic growth, at least for the foreseeable future. This means that if growth were to be abandoned as an objective of policy, democracy too would have to be abandoned... (T)he costs of deliberate non-growth in terms of political and social transformation that would be required are astronomical."

This combination of, on the one hand, the portrayal of continued economic growth as inevitable with, on the other, the argument that the alternatives are beyond contemplation effectively results, then, in such a value being established as an 'ethical imperative' which is beyond question. This tendency is strengthened by the general belief, inherent in technocratic rationality, that to question established values is to display tendencies towards 'irrationality' and 'emotionalism' or questionable motivation (see Section 9.2 above). For example, Greenhalgh (op cit p224-5) argues that the public are being...

"...deliberately, perhaps even cynically, manipulated by a much smaller group of people who, dissatisfied with the present industrial society are seeking to change what they regard as its materialistic acquisitive values and to impose an 'alternative society'."

A general concept of 'technological progress' goes hand in hand with economic growth to define the materialist orientation of this perspective on the energy problem. It, too, tends to be portrayed as an inevitable process which proceeds as we find out more about the "...fundamental laws of nature and society" (Döderlin 1976 p202). In his evidence to the Sizewell B Public Inquiry (Transcript Day 52) Len Brookes refers in several places to the ... "onward march of technical progress" (eg ibid p10, 38). And it is also argued that to question such progress is a mark of 'irrationality'; for example, Weinberg (1979) argues that it represents a ... "cynical denial of human ingenuity"..., while Spinrad (1975) suggests that it proclaims a 'fascist viewpoint' to the extent that it postulates alternative lifestyles. Its unquestionable desirability is therefore combined with that of the value of economic growth to form a 'materialist ethical imperative' underlying this pro-nuclear perspective on the energy problem. Within the programme of technocratic rationality, to accept this imperative without question is to adopt the 'rational' approach to the planning of the future, seen as a value-free process;

to question it is to be guilty of making irrational value-judgements, of attempting to impose ideas on society and of unacceptably negating the rational essence of human existence.

Having established such material values as ethical imperatives the next element in the framework concerns the implications of the achievement of such values for society's energy requirements. This element basically rests upon arguments concerning the relationship between the growth in GDP on the one hand and the growth of energy consumption on the other (a relationship expressed in the 'energy coefficient'). While recognising tendencies for the energy coefficient to decline over time due to the impact of rising prices and saturation effects, supporters of nuclear power nevertheless tend to place considerable emphasis upon the continuation into the future of past trends with relatively little modification. Great weight is given to those factors which are seen as militating against the 'decoupling' of energy consumption from economic growth and it is argued that continued growth must mean more energy consumption (cf Greenhalgh 1980 p4-7; Starr 1982; Bethe 1978). To quote Sir John Hill again:

"(T)here is an almost direct relationship between gross national product and energy consumption. We can certainly save energy by conservation but the linear relationship covers such a vast span, the general philosophy that material growth requires more energy cannot be denied." (Hill 1977 p3).

A central component of the viewpoint adopted on this question of the relationship of energy consumption to future economic growth is, then, a stance on the question of the potential role of energy conservation in reducing the energy coefficient. This issue will be analysed in greater depth in the next section (cf p426) but it is relevant to refer here to the tendency of supporters of nuclear power to adopt a rather pessimistic attitude concerning this potential. This can be seen to be due partly to an adherence to certain cognitive beliefs about economic processes



(beliefs which are value-conditioned) but also partly to certain normative dispositions in relation to the question of taking steps to 'interfere' with energy demand. Thus, it is possible to see here, once more, a commitment to 'liberalist' principles which regard the consumer's autonomous preferences as sacrosanct and any attempt to interfere with their free expression in the market as representing a move towards ... "a dirigistic economy with an associated police state." (Greenhalgh 1980 p3; cf Weeks op cit).

The 'bottom line', then, of this perspective on the energy problem is a concern to ensure that energy supplies are available to provide for the continued march of economic growth and technological progress. Attempts to 'solve' the problem as thus formulated, although presented simply as involving the 'technical' assessment of alternative means on the basis of the relevant factual information, must rather be seen as a value-contingent process. As interpreted by supporters of nuclear power the energy problem can be seen to imply a normative orientation comprising a combination of the themes of 'materialism' and 'liberalism' and to involve tendencies towards the elevation of values into 'ethical imperatives'. Such tendencies reinforce those of the programme of technocratic rationality which imposes such values on the debate about nuclear power in the name of value-freedom. Since it is argued that values cannot be rationally questioned, alternative normative positions to the dominant themes are dismissed as the basis for irrationality in the debate while these dominant themes become hypostatized.

#### 9.3.4 Conclusion

Having analysed interpretations of the energy problem which tend to be associated with the pro-nuclear 'policy paradigm' and attempted to identify its primary normative underpinnings, it remains in this section to indicate

the major implications of the latter for the concept, embodied in technocratic rationality, of rational and efficient debate and decision-making about alternative means on the basis of value-free scientific knowledge. Two such major implications can be identified. The first concerns the nature of the knowledge which is brought to bear on the debate concerning the implications of alternative energy policies. I have argued that such knowledge is necessarily value-contingent but it is now possible to be rather more specific in the context of the implications of the development of nuclear power. Therefore, in the next section I shall briefly attempt to indicate the way in which the dominant values identified might influence the knowledge employed in debate and decisions about nuclear power.

The second important implication relates to the range of means which is included within the ambit of rational consideration. Rationality in the consideration of means implies that all possible alternative means are included in the analysis. However, the implication of the above analysis of interpretations of the energy problem is that such interpretation circumscribes the consideration of means thus restricting the bounds of 'rationality' with reference to particular values. This implication will also be examined in greater detail in the next section.

## 9.4 Nuclear Power and Alternative Energy Policies

### 9.4.1 Introduction

The central value judgement of technocratic rationality relates to the claim that the process of debating and making decisions about nuclear power and alternative energy policies should be confined as much as possible to technical considerations which can be defined in terms of objective facts;

normative considerations should only enter the process at the final stage, when all the implications are known, in establishing appropriate trade-offs between achievement of different defined ends. There are, therefore, 'rational' and 'irrational' components of the decision-making process and decisions will be 'better' if the influence of the former component is maximised. As a value-judgement, this claim can be assessed in relation to its wider implications and can be questioned on normative grounds, as can any value judgement. However, the force of the value judgement must also be related to the question of the logical feasibility of the programme that it implies. Therefore, in this section the critique will illustrate the problems which arise for the claims of technocratic rationality in respect of the feasibility of the programme of the consideration of alternative means. Firstly, I shall provide some illustrations of the extent to which the scientific knowledge which can be employed in the nuclear power debate departs from the ideal required by technocratic rationality: secondly, I shall illustrate the way in which the consideration of alternative means can be circumscribed by the perception of the energy problem and the way in which normative considerations play a role in this process; and, finally, I shall briefly consider the problems which arise for technocratic rationality from the requirement to establish trade-offs between costs and benefits at the 'evaluation' stage and the ways in which such problems are accommodated.

#### 9.4.2 The Problem of Knowledge Revisited: Some Illustrations

In the first part of this thesis, particularly in Chapters 3 and 4, I attempted to analyse in some detail the problems which prejudice the development of knowledge about the social world which can be considered to be 'reliable' or 'cognitively well-founded'. As regards the

development of knowledge which can be employed to inform debate and decision about future energy policy there are significant components of scientific and engineering knowledge the 'reliability' of which is not fundamentally in dispute, but the major body of relevant knowledge relates, in general terms, to the impact of technology on human social and economic development about which there is a substantial degree of controversy. I have indicated in some depth the serious problems which arise for the production of such knowledge from the complex 'open systems' nature of social and economic systems and from the severe difficulties in establishing controlled experimental situations. These general problems can be elaborated upon with reference to certain characteristics of the debate about the implications of the development of nuclear power.

Firstly, there is the problem referred to earlier (cf p279) and noted by Häfele (1974), Lovins (1975) and Otway and Von Winterfeldt (1982) that, in Weinberg's words, ..."the advent of nuclear energy poses issues of unprecedented magnitude and weight for mankind"... (quoted in Lovins op cit p11). Lovins himself (ibid) elaborates:

"The very large inventories of fission and activation products in the nuclear fuel cycle create hazards unlike those of any other single technology. These hazards combine the geographic range of certain military pathogens, the permanence of irreversible changes in climate or in soil fertility, and the medical and moral significance of the most persistent synthetic mutagens, all potentially at a substantial level. Because this unique combination of inherent hazards departs so much from our experience, we must define with special care, before we choose to incur these hazards, the limits of our ability to cope with them."

A fundamental problem therefore arises for the development of knowledge about such potential consequences, because, in addition to the problem of experimental control, there arise situations in which it is not possible to experiment at all. Boldly stated, the central difficulty is that because the consequences are unconscionable we cannot afford to

be proven wrong and therefore we cannot experiment. The scale of the potential collective 'social costs' of nuclear technology, in relation to safety and environment (and, indeed social and political) implications, is such as to present a threat to the 'basic parameters of our normal existence' (Häfele op cit) should 'errors' occur. Of course, this situation presents severe difficulties for the programme of empirical falsificationism: if the worst case scenarios in respect of, for example, major reactor accidents and implications for civil liberties are considered to be unacceptable then it must be inappropriate to judge the 'scientific' quality of arguments that reactors are safe and that there is no threat to civil liberties in relation to their potential falsifiability.

In the absence of the possibility of experimentation to derive direct empirical information other forms of knowledge become necessary like, for example, analogies with other systems where experiments can be conducted, formal models designed to simulate system performance or sets of hypotheses and assumptions based upon some background theoretical framework. In all such cases considerable reliance must be placed upon judgement and assumptions which may be rather remote from empirical scrutiny. Moreover, the corollary of the potential scale of the social costs of nuclear power is a strong ethical and moral dimension to the debate and therefore considerable scope exists for the judgements and assumptions which become such important elements in knowledge formation to be influenced by this normative dimension.

The situation is compounded to the extent that much of the knowledge employed in the nuclear power debate relates to the future. The most important aspect of the debate is concerned with the implications of proceeding with a programme of investment in nuclear power, compared with alternative energy policies, over a period into the future. Such knowledge could potentially only be refuted on the basis of outcomes at some future

point in time but this provides no effective 'quality control' on the knowledge at the time that it is required - that is, at the present time when it is needed to inform decisions. If, for example, it is currently believed by policy-makers that a particular programme of investment in nuclear power is necessary to maintain a particular level of economic growth and will produce a net benefit of £X by a particular date, and the programme is pursued on that basis, then failure of such benefits and the expected growth rate to materialise at that date cannot provide a meaningful criterion of 'scientificity' of the initial belief. The first problem is that it is too late - the 'damage' is done and it is irretrievable; the second is that the original belief could still be defended on the grounds that changes in other factors were responsible for the failure (ie 'ceteris' were not 'paribus') or, for example, that the timing of the benefits is not central to the belief and that they could still materialise at a later date. Such 'ex post' reasoning is of little use when 'ex ante' criteria are needed to indicate the validity of beliefs. Moreover, since past experience can provide no warrant for future expectations assumptions about the future become fundamentally important in the development of the required knowledge and, again, choice of assumptions is very much a matter of 'informed judgement' which is open to value-conditioning.

Therefore, something of a 'planning dilemma' can be seen as arising which creates problems for the energy policy-making process. Because of the large investment sums that are required for nuclear power programmes and the magnitude of the possible implications of such programmes for the economy, environment and society, there is an important requirement for 'reliable' knowledge about such implications in an ex ante context - in advance of, and as an input to, decision-making. Yet these very same characteristics exacerbate the problems which stand in the way of the development of such knowledge due to, for example, long planning and

investment lead times, the denial of opportunities for experimentation, and the introduction of strong moral and ethical considerations. This type of dilemma is common (to a greater or lesser degree) to policy making in respect of all social and technological systems (cf Hutchison 1981 p284), especially those requiring large-scale investments, but is arguably made particularly acute in the case of nuclear technology by the potential impact of radiation releases.

There exist, then, several serious problems with the conception of knowledge which is required for the achievement of the ideal of 'rational' debate as propounded by technocratic rationality. A common response to the recognition of some of these problems is to suggest that the branches of science involved are 'immature' and that the answer is for them to adhere more strictly to the results of falsificationism. For example, Hutchison (1981 p275-6) refers to a 'vicious circle of immaturity' in his examination of economics:

"(T)here may well be a danger of a kind of vicious circle of 'immaturity' in a subject like economics, which is urgently concerned with policy problems - and hence political power - in that difficulties of testing, and the extent of ignorance, leave a vacuum filled by bias and ideology, which in turn makes critical testing more difficult." (ibid p276).

He goes on to suggest that such problems might be alleviated by greater adherence amongst economists to the 'methodological prescriptions of critical testing and testability' (ibid p298), a position echoed in Blaug (1980). However, this position can be seen as side-stepping the central problem by referring to an untenable ideal. From the perspective adopted here, the concept of 'immaturity' seems inappropriate since it is in the nature of the social sciences that their knowledge develops in relation to the solution of policy problems and that such knowledge is necessarily thoroughly conditioned by values. It is argued,

therefore, that, although a critical approach to knowledge development is indeed of crucial importance, it is nevertheless inappropriate to judge questions of 'reliability' by the standards of the natural sciences and that the kind of 'planning dilemma' discussed above is an inherent characteristic of public policy-making systems and not something that can be eliminated by an attempt to 'improve' social knowledge with reference to 'naturalistic' standards.

However, such an attempt has indeed constituted the predominant response to the perception of the types of problem embodied in this dilemma. The result has been a tendency to formulate the required knowledge, wherever possible, in the guise of formal quantitative schemes which are perceived as enabling the more objective and reliable simulation and forecasting of the relevant system properties (Lovins 1975 p11-12, 25; Otway and Von Winterfeldt 1982 p248-9). Indeed, Häfele (1974) recommends this trend towards increased 'formalisation' of the debate in order to overcome the problems manifested in the 'planning dilemma'. The general point is made by Otway and Von Winterfeldt (op cit) in relation to the attempts to establish criteria for 'acceptable risks' of technological developments in response to the perceived problems of the lack of experimental knowledge and the strong normative basis of the opposition to such developments:

"Puzzled by these confusingly different values and beliefs, and their perseverance in the face of 'rational technical argument', demands were put forward by industry and others for predetermined criteria by which the acceptability of risks could be judged. Since technical experts tend to have a mathematical orientation and possess analytical skills, it is perhaps not surprising that they began to search for quantitative risk acceptance criteria. An implicit assumption here is that social preferences can be expressed in engineering terms and used in the regulatory process to reduce uncertainty, ambiguity and delay - in essence an attempt to model social and political behaviours with the technical tools and the philosophy of the natural sciences." (ibid p249).

As argued in Chapter 3 such approaches to knowledge development commonly proceed under the justificatory banner of falsificationism but bear little



actual relation to its imperatives: the predictions cannot be falsified with reference to empirical evidence. As Kuhn (1977 p283) implies, it would seem that here we have an example of falsificationism serving more as an 'ideology' than as a workable logic of knowledge. However, the problem goes deeper than this and relates to the role of assumptions in the development of knowledge. The untenability of the falsificationist position implies that the role of assumptions must be subject to close scrutiny since they are of crucial importance in the formation of knowledge. The problem is compounded by moves towards the increasing development of formal systems of knowledge because while, on the one hand, such systems are constituted so as to give the appearance of not having a strong assumptive basis, they nevertheless, on the other hand, can be seen as incorporating assumptions in an increasingly complex manner. The problem is perhaps implied in Kendall's criticism of the use of mathematical models in safety analysis quoted by Lovins (1975 p25):

"Mathematical models cannot be used reliably to span large gaps in engineering knowledge, owing to the very great uncertainties that accumulate in long and unverified chains of inference."

In such chains of inference assumptions must play a central role.

Assumptions can be seen as playing a variety of roles in the process of knowledge development (cf Blaug 1980 p105-10; Hutchison 1981 p289-93). Three main types of assumptions can be identified. Firstly, 'negligibility assumptions' play a role in the process of abstraction from 'reality-as-perceived' of those factors which are considered to be important, with the corresponding neglect of those whose influence is considered to be 'negligible'. Secondly, 'domain assumptions' specify the circumstances under which a model, hypothesis or theory is considered to be applicable ie its 'domain of applicability'. Thirdly, 'heuristic assumptions' are used to simplify complex processes by, for example, taking one factor

at a time and arguing 'as if' other factors were not present. Moreover, assumptions may be 'generative' in that they are used to derive a model or hypothesis, or they may be 'auxiliary', used in conjunction with a hypothesis in order to deduce its consequences (eg 'ceteris paribus').

Now, Hutchison (op cit p291-3) argues that considerable confusion surrounds the role of assumptions because it is often unclear precisely what kind of assumption is being invoked. Both he and Blaug (op cit) dismiss the 'instrumentalist', Friedmanite version of falsificationism, which argues that assumptions need not be tested, and argue instead for a more 'sophisticated' version which involves the testing of negligibility and domain assumptions. However, in view of the general problem of empirical testing outlined in Chapters 2 and 3 it is difficult to see how the question of the validity of assumptions can be reduced to the empiricist formulation. For example, take the case of the development of an economic model of consumers' demand for energy which is to be based on the neo-classical assumption that consumers behave rationally with a motivation to maximise utility. As a negligibility assumption this would involve assuming that 'non-rational' consumer behaviour is negligible as an influence on energy demand; as a domain assumption it would involve the argument that the model is applicable only in cases where consumers' behaviour is rational; and as a heuristic assumption it would involve using the model to analyse the process of consumers' demand for energy 'as if' the behaviour of such consumers were rational.

If this assumption is employed in the 'heuristic' sense then there exists no empirical problem to the extent that the model is used to analyse what consumers' energy demand would be if they all behaved rationally without making any statement about the actual relevance of the model to the 'real world'. If any such statement becomes implied then, of course, problems arise because the nature of the assumption is undergoing change to a

negligibility or domain assumption. If it is argued that the model is relevant because consumers do behave rationally then the assumption cannot be tested because the only test of 'rationality' is the extent to which the model 'fails' to predict the relevant observations. But failure is a matter of judgement in statistical inference and can, in any case be blamed on violated 'ceteris paribus' assumptions. Therefore, the domain assumption cannot be tested either; if it cannot be established when behaviour is not rational then neither can it be established that the model is inapplicable to those circumstances.

Consequently, it can be seen that the assumptions upon which the process of knowledge development is based are not readily amenable to empirical testing and that there is a tendency within the falsificationist position to neglect their importance; and it can be argued that the degree of this neglect is proportional to the extent of formalisation and quantification involved. However, assumptions do indeed play a very important role in knowledge formation: they provide statements about the motivation and behaviour of people engaged in various economic, social and political activities; they provide criteria for what are to be taken as relevant and important factors and variables and for the appropriate form of representation of such variables in a particular knowledge formation; and they provide statements on the existence and stability of certain functional relationships in the system of interest (cf Blaug op cit p107). In the absence of strict 'empirical accountability' the nature of such assumptions must be largely a matter of judgement in relation to a particular conceptual framework or paradigm and, as argued in Chapter 4, such judgement is open to conditioning by values.

For example, in the case looked at above the commitment to the assumption of rationally-behaving, utility-maximising individuals can be related not to its empirical veracity but rather to value judgements which argue that

individual preferences should be sacrosanct which in turn can be related to a favourable disposition towards the type of society implied by the 'liberalist' theme outlined in Chapter 6. However, such influences can operate in a less direct manner to the extent that there are value implications in an apparently value-free approach. For example, adherence to the rationality assumption might be justified on the grounds of a commitment to purely 'scientific values' of a paradigm; it could be argued that the assumption is an integral part of the framework of neo-classical economic theory and that such a framework represents the epitome of value-free scientific knowledge. However, this approach merely asserts the value-commitments of the neo-classical framework in the guise of a spurious 'value-freedom'.

Against this background it is now possible to refer to some specific examples of the type of knowledge which is brought to bear upon the debate about nuclear power, with particular emphasis on the pro-nuclear perspective within which so much weight is placed upon the employment of objective factual knowledge in a rational debate. In Chapter 3 I paid a considerable amount of attention to the nature of economic knowledge firstly due to the importance of this knowledge in the nuclear power debate and, secondly, because such knowledge is conventionally seen as the most cognitively reliable of all social scientific knowledge. We can point once again to the reference, by the Department of Energy's witness at the Sizewell B Inquiry, to the "hard economics" of energy planning (cf above p409); and also in relation to the Sizewell proposal Brookes (1982) argues for the virtual 'self-evidence' of the case on the basis of what he considers to be an uncontestably firm and simple economic analysis. Notwithstanding such a view, there exists, as indicated in Chapter 7 and in section 9.1 above, a considerable degree of dispute in the cognitive dimension about the economic implications of nuclear power. The two main interrelated areas of dispute concern, firstly, the relation-

ship between nuclear power and economic growth and, secondly, the cost of nuclear-generated electricity.

As regards the first of these areas we can briefly restate the essence of the disagreement. On the one hand, supporters tend to believe that if continued economic growth is to be ensured then the scope for energy savings is relatively limited. In a 'business-as-usual' future failure to provide nuclear power is seen as a recipe for energy shortages and high energy prices which would promote economic recession and stagnation. In such a situation further required investment in energy supply would be restricted creating the prospect of an 'energy-economic trap'. In order to avoid this, additional nuclear capacity is required as soon as possible to stabilise energy prices and help to secure the growth in GDP which would otherwise be foregone. The supply of capital is seen as creating no insuperable problems being generated by the growth which nuclear power helps to promote.

On the other hand, opponents of nuclear power tend to argue that there is considerable scope for energy savings with no threat to economic growth. Indeed, it is argued that a greater emphasis on conservation and efficient energy use may well be the best means of ensuring such growth due to its lower capital intensity. Opponents tend to be critical of the belief that capital-intensive, supply-oriented futures provide the best guarantee of economic benefits and emphasize problems of the supply of capital and its unproductive use over long construction periods and advantages of more labour-intensive investments as promoters of economic growth and welfare. Consequently, there exists divergencies of beliefs concerning the macro-economic implications of alternative energy policies; supporters and opponents tend to argue from within rather different theoretical and conceptual frameworks. To what extent, then, is this dispute to be resolved with reference to 'the facts'? To illustrate the

problems in this view we can refer to a macro-economic model of the relationship between energy and the economy which was elaborated by Len Brookes at the Sizewell B Public Inquiry to elucidate the economic case for nuclear power with allegedly close reference to the empirical 'facts' and to the economics of the 'real world' (cf Brookes 1983 p9-47). I shall also refer to the macro-economic model implied by the analysis provided by the Department of Energy as a basis for its projection of future energy demand (Department of Energy 1982).

The stated aim of Brookes' interesting analysis, then, is to provide a 'simple model' which will provide insights into the way in which high energy prices can constrain economic activity in the context of a closed economy when all the variables (except an assumed initial shift in the supply curve) are endogenously determined by ... "the equilibrium seeking forces in the system itself... as they are in the real world." (Brookes 1983 p30). More specifically, he is concerned to show how nuclear energy can relieve current and future 'energy supply constraints' upon economic activity and that it is 'unsound' to look for high levels of energy conservation or other 'high cost' alternatives to nuclear (ibid p10). Firstly, he outlines a set of theoretical propositions supported by various assumptions. The agent of human economic activity is characterised as 'entropy-accelerating economic man' whose goal is asserted as being not to minimise energy consumption but rather to maximise welfare by seizing the available economic opportunities, the most important of which is seen as the continual substitution of low-cost energy (complementary to capital) for scarcer inputs (eg labour) so as to increase factor productivities, improve the efficiency of the whole productive process, increase per capita incomes and therefore continually move to higher states of economic welfare (ibid p13-16). In this process energy efficiency increases simply due to the 'onward march of technical progress' stimulated by the search for economic efficiency which in turn is facilitated by the availability of low-cost energy supplies.

On the basis of this theoretical scheme, Brookes argues that high fossil fuel prices do not promote increased energy efficiency, as conventionally argued, but rather have an adverse effect via constraints on the process of factor substitution and therefore on economic growth and technical progress (ibid p17-22). The hypothesis underlying his model is, therefore, that the availability of energy is a 'driving force' in the economy as much as the level of economic activity is an important factor in the demand for energy. Consequently, a change in the 'availability' of energy to the world economy (defined in terms of both price and quantity supplied) will affect the level of economic activity; in particular, a reduction in 'availability' (eg increase in price) will constitute an important economic constraint, cause a shift to a lower demand curve for energy and promote a new equilibrium situation which will involve a lower employment of other factors of production. The economy will suffer because capital which would otherwise have been used complementarily to labour and energy to increase economic output will, instead, be used in investment to increase energy efficiency (ibid p22, 25-7).

Brookes argues, then, that this 'simple model' based on both economic theory and empirical evidence, is ... "a surprisingly good one in the real world." (ibid p27). However, it is evident that it is based primarily on deduction from theoretical propositions and assumptions the empirical veracity of which is not established by the empirical evidence that he brings to bear upon the analysis. Indeed, most of evidence is referred to in the context of an attempt to refute the hypothesis that high energy prices result in a reduction in the energy coefficient and such evidence lends only indirect support for the model proposed (cf ibid p17-22). His model and its underlying hypothesis is not open to refutation on the basis of its predictions; as he argues (ibid p30) the model is based on considerable simplification involving negligibility

and heuristic assumptions, and the required 'ceteris paribus' assumptions could never hold. Consequently, the value of the exercise becomes a matter of informed judgement about the 'reasonableness' of the assumptions and theoretical propositions involved taking into account interpretation of the rather patchy and inconclusive empirical evidence that is available. This, I would argue, is indeed the nature of the social scientific enterprise. It implies that we must reject both Brookes' claim of 'cognitive reliability' for the model on the grounds that it fits the facts of the 'real world', and any claims for the 'cognitive unreliability' of the model on the grounds that it cannot be refuted in relation to such facts.

The problem of this type of knowledge is further illustrated by the macro-economic model implied by the Department of Energy's analysis for the Sizewell Inquiry. This model involves the very hypothesis about the relationship between energy price and economic growth which Brookes seeks to refute using his own model. Essentially, the hypothesis employed by the Department of Energy has the main direction of causality going from economic growth to energy prices, precisely the opposite of the Brookes hypothesis; from the point of view of the analysis of energy problems, economic growth can be taken as an exogenous variable:

"It is sometimes suggested that high world energy prices would prevent the achievement of high rates of economic growth. Although high energy prices are likely to place some constraints on economic activity, the fundamental forces generating economic growth arise, in the main, outside the energy sector." (Department of Energy 1982 pA4, para 16).

Consequently, the Department of Energy derives scenerios which involve the combination of assumptions of high fossil fuel prices and high rates of growth, reasoning that high economic growth will create high energy demand growth which will bear on energy supplies to cause high rates of increase in energy prices (cf Transcript Day 42 p34-6). Brookes rejects such



scenarios as inconsistent arguing that high energy prices will prejudice economic growth which must be treated as an endogenous variable.

It is difficult to see how this dispute can be resolved in relation strictly to empirical evidence. From both positions it is accepted that some degree of interdependence is present in the system and in the context of such interdependency empirical evidence on the degree of directionality could easily be taken on board by both sides. However, given the complex, open-systems nature of macro-economic systems empirical evidence which can be interpreted in a clear-cut manner is virtually impossible to obtain.

A more pronounced disagreement arises between Brooke's position and that of opponents of nuclear power who argue for measures to increase the efficiency of energy use and, therefore, to reduce energy requirements for any given level of economic activity. The arguments will be referred to again in the next section (cf p447) but have interesting implications for the present discussion. The position referred to is basically that propounded by Leach et al (1979) and Brookes attempts to refute the argument with reference to the 'evidence':

"All the evidence is against them. Since the dawn of the industrial revolution no country has been able to produce sustained significant economic growth without a corresponding growth in energy consumption." (Brookes 1983 p12)

This 'evidence' is backed up by, for example, the following assertion:

"The diversion of resources to energy saving may amount to a misallocation of total resources at the macroeconomic level - ... it takes the form of diverting resources from investment that is complementary to energy use to investment that is in substitution for energy use - and where costs can be shown to be reduced by greater efficiency of energy use analyses may overlook that the income that is thus released may fall upon energy intensive goods and services." (ibid p13). (emphases added).

Such 'evidence', therefore, amounts to no more than rather imprecise hypotheses, not expressed in falsifiable form, and as such departs significantly from the conception of 'facts' which underlies the position from which the criticism is made.

Moreover, in this critique of the advocates of energy efficiency we obtain an indication of the nature of the normative basis of the argument. Brookes argues that the greater the conservation response to increased energy prices, in the form of measures to increase the efficiency of energy use and therefore offset the reduction in economic output, the greater the adjustment towards accommodating higher price levels (as resources are substituted for energy) and hence towards promoting a higher level of equilibrium production and consumption of energy (ibid p29). In this situation, he argues, there is a welfare loss associated with a shift of resources into measures to save energy at the expense of other goods and services which ... "given the choice, no doubt most consumers would prefer to spend their incomes on..." (ibid). In other words, Brookes suggest that the apparent welfare gain from increased spending on conservation measures is illusory because the 'goods' involved are 'regrettables' (ie means to avoiding disbenefits) and therefore do not constitute proper benefits. His conclusion is that ... "it would be much nicer if we could have cheaper energy and ... (produce)... the things we would much rather have." (ibid p30).

Now, this critique can be seen as involving a complex set of value judgments. Essentially, Brookes is comparing two possible equilibrium states which involve different levels of energy prices, consumption and production, industrial structures and different compositions of final outputs of goods and services. In both these states consumers are seen as maximising their welfare, exercising their free choice in the market in relation to the prevailing prices. Therefore, the normative stance

embodied in the 'liberalist' theme is in evidence arguing that individual preferences should count and welfare is thereby maximised. However, an additional value judgement is being invoked to argue for one of these states in preference to the other and this involves using the value-laden term from welfare economics - 'regrettables' viz 'goods' which consumers will prefer in particular circumstances but which, it is judged, society would be better off without (if the reason for them could be eliminated) and the resources involved reallocated. Here we can see the 'materialist' theme at work producing a value judgement in favour of the state in which the output of particular types of goods and services is maximised because they are judged to be 'worth' more to the consumer.

This rather lengthy consideration of the nature of the macroeconomic knowledge which is brought to bear upon the nuclear power issue has illustrated the extent to which such knowledge departs from the conventional positivistic notion of 'objective facts', is rather founded upon theoretical propositions and assumptions which are not strictly falsifiable in relation to empirical evidence, and, moreover, is value-conditioned. Such findings do not in any way invalidate such knowledge as an important basis for the debate; rather, it illustrates the invalidity of the conception of 'reliable' and objective knowledge which underlies the imperatives of technocratic rationality. Some further illustrations can be briefly referred to.

The second major element in the debate about the economic implications of nuclear power development concerns the cost of nuclear-generated electricity compared to that generated by alternative means (in particular, by coal-fired power stations). As indicated in Chapter 7 above, the degree of dispute is considerable and basically concerns the extent to which investment in a nuclear power station (or series thereof) will result in savings in costs over the whole generating system compared to

what they would otherwise have been (ie with no investment or with an alternative investment). In this context, the dispute about historic, allocated total generating costs is essentially irrelevant (Department of Energy 1981 para 4.01); rather it is the marginal cost implications of pursuing alternative future courses of action which are important and allocated historic costs do not provide a reliable guide to such future implications (cf Turvey and Anderson 1977 p7-9). Consequently, to employ information relating to the 'ex post' allocated costs of nuclear-generated electricity as a basis for arguing, 'ex ante', for future investment in nuclear power (as is sometimes implicitly done, eg Hill 1981B) is to refer to 'facts' which are inappropriate to the decision at hand; moreover, even such 'facts' are open to dispute due to the degree of arbitrariness in cost allocation conventions (cf the problem of allocating overhead costs - Turvey and Anderson op cit).

When it comes to the 'facts' about future marginal cost implications the uncertainties proliferate to a point at which such knowledge bears little relation to the model of 'cognitive reliability' embodied in technocratic rationality. The estimation of the net effect which the construction and operation of a new power station is expected to have on the total generating system costs over its lifetime involves two primary stages (see also Chapter 7). Firstly, for any proposed new generating plant the initial capital cost, lifetime operating costs and decommissioning cost are compared with the marginal savings accruing from the reduced load factor and hence fuel requirement of lower merit stations; this gives an estimate of 'net effective cost'. Secondly, for stations which might be decommissioned as a result of the introduction of the new capacity, estimates are made of the avoidable costs of retaining them in service as opposed to retiring them - the 'net avoidable cost'. On the basis of this information an assessment can be made of the economic benefit of investment in new capacity arising from reductions in total

system generating cost due to both the introduction of the new capacity and the displacement of older plant with the highest avoidable costs (CEGB 1982A Chapter 9; Baker 1982 para 52-3; Jenkin 1982 para 20-4).

Since such estimates have to be made for time periods extending well into the future they necessarily rely heavily upon judgements and assumptions about what is likely to happen. As Baker (op cit para 53) states:

"The process is complex because the various inputs and assumptions underlying the calculations - plant costs, construction times, performance and fuel prices over the life of the project - are themselves subject to considerable uncertainty, so that a range of outcomes must be possible."

Indeed, in the CEGBs Statement of Case for the Sizewell Inquiry, the discussion behind the derivation of assumptions underlying the cost estimates refers in several places to the 'reasoned judgement' which is so important in generating assumptions in view of the considerable uncertainties involved (CEGB 1982A Chapter 7; Wilson 1982). In view of the crucial importance of assumptions relating to future levels of fossil fuel prices it is not surprising that there arose a considerable degree of controversy on this question at the Sizewell Inquiry. For example, the issue was addressed in most of the cross-examinations of the Department of Energy's evidence during which it was made clear that such assumptions were based very much on judgement about likely outcomes on the basis of theoretical preconceptions relating to the operation of world energy markets (eg Transcripts Day 42 p40-5; Day 46 p88-9). Specifically, reference is made to the basis for the Department of Energy's coal price assumptions:

"The coal price assumptions have been derived on a judgemental basis after consideration of possible growth paths in the marginal production costs of Appalachian coal." (ibid Day 46 p88).

The problem of the derivation of assumptions about future fossil fuel prices can be related back to the discussion above of macroeconomic models (cf p426). As the CEGB's sensitivity analyses indicate (CEGB 1982A p60-1), the calculations of net effective costs of nuclear plant are highly sensitive to fossil fuel price assumptions and the case for investment in such plant is improved if high rates of increases, particularly of coal prices, are assumed. Within the Department of Energy's macroeconomic framework (a similar one is adopted by the CEGB in their analysis; cf CEGB 1982A Appendix C) assumptions of high rates of economic growth work through to assumptions of high fossil fuel prices, required to balance energy demand and supply; therefore, the case for nuclear power is reinforced both in terms of requirement for new capacity and in terms of the replacement of (high cost) fossil-fired plant. On the other hand, in his alternative framework, Brookes starts with the argument that the introduction of new nuclear plant will reduce total generating system costs and therefore provide a favourable shift in the supply curve for energy, and argues that this will generate the required economic growth by keeping down energy prices (Transcripts Day 52 p41-6; Brookes 1982). A potential difficulty is produced here to the extent that the lower fossil fuel prices which would result from the development of nuclear capacity might result in less favourable net effective costs; however, Brookes sees no problem here arguing that the case for nuclear power is robust against lower coal prices (ibid). It can be seen here that the basis for the arguments is provided by an intricate web of judgements and interpretations about the nature of the complex inter-relationships between energy and economic systems for which there is little direct empirical support.

It is, perhaps, finally worth referring briefly to a further set of assumptions required in the assessment of the net marginal cost implications of new generation options which have a bearing on the cognitive basis of

the economic evidence for nuclear power. The problem is that the evaluation of the benefits of a particular power station must take the relevant costs and savings over its whole lifetime; however, during this period a large proportion of the total generating capacity in the system will have to be renewed and the savings which will accrue to any one station will depend on the way that the mix of other generating plant develops (CEGB 1982A p54; Jenkin 1982 p25-37). Therefore, estimates of the economic benefit of a nuclear station, required for decisions now, are contingent upon the nature of future decisions about investment in nuclear power. This can be seen as representing an additional complicating factor in the 'planning dilemma' referred to above (cf p.419) concerning the development of knowledge to inform decisions about investments which have impacts over long periods into the future. The general problem is recognised by the CEGB in terms outlined by Jenkin (1982 para 38):

"The forecasting problem is a formidable one partly because of the complications resulting from... (macroeconomic)... interrelationships ...but also because of the significant uncertainties in formulating any forecast of all the variables for the more distant future. Many alternative outcomes are possible and each outcome has its implications for the preferred development of the electricity system. The CEGB therefore has to plan to meet its statutory obligations although the future is unknown, and must make estimates of the future knowing they are unlikely to be right."

Of course, recognition of this problem is difficult to reconcile with the requirement to make decisions which involve the commitment of large amounts of resources, with a significant opportunity cost, and which must therefore be presented as 'reliable' and 'well-founded'. Moreover, since stances in debates about public policy issues like nuclear power are conditioned (to a greater or lesser degree) by values, and this influences the development and selection of 'relevant' knowledge, it can be argued that to take on board the implications of the 'planning dilemma' would be to jeopardise the wider 'legitimacy' of one's position in the

context of the dominant ideological themes of 'technocratic rationality'.

To round off this examination of the nature of the knowledge which is employed in the debate about nuclear power, we can refer very briefly to some of the implications which were discussed in Chapter 8 under the classification of the 'social costs of nuclear power'. The primary issue in this area of the debate concerns the safety of nuclear power and the two main areas of controversy relate to the health implications of 'routine' low-level radiation releases on the one hand, and to the risk of a major accident on the other. Therefore, we are concerned here with the 'factual' basis for the confident assertions which are often made about the safety of nuclear power. As regards the issue of the implications of 'routine' releases of low-level radiation in normal operation, the protection procedure recommended by the International Commission for Radiological Protection (ICRP) upon which UK radiological safety criteria are based, is founded upon the 'linear dose-response hypothesis' (cf above p323). However, there is considerable controversy about the scientific evidence for the effects of radiation at low dose levels (Pearce et al 1979 p144).

On the one hand supporters of nuclear power tend to place weight on evidence which indicates that low radiation doses have no lasting harmful effects and that there exists a threshold below which a safe dose can be defined. Consequently, they argue that the linear hypothesis overestimates the risks (cf Wade 1981 p292-3; Little 1983A); Weinberg (1978 p75) implies that the problem lies in the scientific evidence and that "...as more scientific information is obtained, our beliefs as to the hazards of radiation may change, and ...these hazards may be judged to be less rather than more." Little (op cit), in her evidence to the Sizewell Public Inquiry, argued that support for the linear hypothesis reflected an increasing tendency by scientists to abandon the 'scientific



approach', which involves the refutation of hypothesis in relation to the facts, and to increasingly confuse 'facts' with 'opinions'.

On the other hand, opponents of nuclear power tend to concentrate on evidence which suggests that the linear hypothesis under-estimates the harmful effects of low-dose radiation. For example, Lindop (1980) points to evidence of increased effectiveness of irradiation at low doses in studies of lung and breast cancer but emphasizes the limitations of the available scientific results as a basis for drawing firm conclusions about the nature of the risks involved. At the Windscale Public Inquiry Professor Radford and Dr Alice Stewart presented evidence to suggest that the linear hypothesis significantly underestimates the harmful effects of low radiation doses (cf Pearce et al 1979 p144-6). In contrast to Weinberg's view, Prior (1980A p10) presents a picture of increasing knowledge indicating larger risks and causing standards to be tightened up.

Therefore, here again we have a situation in which the available 'facts' do not match up to the positivistic conception of them which underlies technocratic rationality. This is also the picture which emerges from a look at the evidence concerning the risk of a major reactor accident. I referred earlier to the problem, in this area, of the impossibility of deriving knowledge about such risks from experience or experimentation and the resultant move towards the employment of mathematical simulation of the behaviour of reactor systems employing probability analysis (cf p417). The resulting evidence about reactor safety expressed in probabilistic form (as presented, for example, in the Rasmussen Study) is widely employed as a firm cognitive foundation for arguments about the safety of nuclear power (eg Hill 1981B; Wade 1981; Greenhalgh 1980, 1981). However, there are certain problems with probabilistic risk analysis which prejudice this interpretation of its results and these can be very briefly referred to.

Firstly, the following criticism is quoted in Lovins (1975 p27):

"(a) There is little or no concrete evidence that the (rare) events under consideration obey the laws of probability that underlie the theory. There is no assurance that accident events are random in time or independent of each other. The intellectually satisfying idea of reliability analysis is no more than a hypothesis for these events; (b) Even if the framework of the theory were correct, the values of the parameters are largely unknown.

The method now generally used to predict these probabilities - cascading of probabilities of the individual 'failures' that make up the event - is known to be inadequate. The serious or potentially serious events that have occurred have been characterized by concurrent failures, usually interdependent or causally related. Thus the theory's assumption of independence of failures has not been borne out by experience."

Secondly, Taylor (1980 p77-8) argues that the probabilities which emerge from such analysis are target probabilities to be achieved in future operation and not 'facts' of reactor operation; whether they are indeed achievable is an open question depending on equipment and organisational performance. Thirdly, in the absence of experiential or experimental data, the assignment of probability can be very much a matter of 'expert judgement' which is not susceptible to falsification. Therefore, as Otway and Von Winterfeldt (1982 p251) argue, ..."many engineering 'facts' about technological risks... (are)... strong held beliefs shared by expert groups."

In view of such problems, then, the apparent objectivity of quantitative probabilistic measures of risk must be seen as illusory; rather such knowledge is necessarily founded upon judgements and assumptions which are themselves open to conditioning by values (ibid p252-3). Certain limitations on the 'scientific' nature (as conventionally defined) of reliability analysis are indeed recognised in the CEGB's safety case for the Sizewell B PWR:

"Where information is not available, for instance for novel or modified components, estimates are made based on engineering judgement which

draws on comparisons with other similar types of equipment. There are, inevitably, matters of interpretation and uncertainties associated with failure rate data particularly for infrequent faults where statistical evidence is limited. For this reason reliability analysis is seen as an aid to judgement rather than a precise science." (CEGB 1982A para 17.33).

However, such qualifications would appear to be all too readily neglected when the debate is projected into the public and political realm (cf Hill 1978, 1981B).

Finally, it is possible to refer very briefly to the realm of the nuclear power debate concerned with 'political' implications ie those related to civil liberties and weapons proliferation. Clearly, as we saw in Chapter 8, argument on these issues rests primarily upon assumptions and hypotheses about what could happen in the future if programmes of investment in nuclear power are pursued, with very little scope for empirical evidence. Even disputes over the 'facts' about what has happened up to the present time, for example, in respect of the interdependence between civil and military programmes must rely heavily on interpretation and judgement. As regards the cognitive basis of these areas of dispute, then, it is possible to make three brief observations. Firstly, the debate can be seen as heavily conditioned by underlying theoretical conceptions relating to the role and purpose of the state. For example, on the one hand the pro-nuclear view that civil nuclear programmes have no adverse implications for civil liberties or weapons proliferation (cf Jones 1980B; Greenhalgh 1980) can perhaps be related to assumptions of a 'benign' state at national level operating in the interests of all groups, safeguarding their rights and liberties, and, at the international level, of the general goodwill of states to work towards a common cause through agreed treaties. On the other hand, the view that the development of nuclear power will have adverse impacts on civil liberties and weapons proliferation (cf Prior 1980B; Flood and Grove-White 1976) may reflect an underlying view of the state as established

in the interests of particular groups and therefore prepared to take measures which would infringe the liberties and rights of some and, internationally, as prepared to place national self-interest above any considerations of a 'common good'. If such basic divergencies of conceptual framework are an important factor then clearly there will remain a degree of 'incommensurability' in the dispute which will be largely immune to empirical considerations.

Secondly, the perspective adopted for the consideration of such implications tends to differ between supporters and opponents of nuclear power in another important respect. On the one hand, supporters tend to adopt an 'incrementalist' view, focussing on the marginal implications of the addition of nuclear capacity and this (combined with an emphasis on the more quantifiable implications) results in a neglect of the problem of the 'indivisibility' of certain implications (cf Jones 1980B). On the other hand, many opponents appear to adopt a more 'holistic' perspective which emphasizes cumulative implications of the projected 'end-state' nuclear economy which might be neglected by the incrementalist approach. This perspective is more in evidence in, for example, Flood and Grove-White (op cit). The incrementalist approach is particularly apparent in the government's present position which involves approaching the assessment of nuclear power on a station-by-station basis (cf Sizewell Transcripts Day 46 p67-8). Again, the existence of such a basic divergence in paradigms prejudices the achievement of agreement in the cognitive realm.

Thirdly, to the extent that the view prevails, within the institutions of the state, that such political implications of nuclear power development are negligible, there will be feed-back effects on the process of development of knowledge about such implications which will effectively tend to reinforce the prevailing view. If such implications are not

perceived as problematical then research in this area will not be promoted or funded as part of the 'mainstream paradigm' and without 'official' blessing research is hampered firstly by problems of obtaining information from various institutions and, secondly, by the consequent 'anti-establishment' label.

This review of some of the areas of cognitive dispute in the nuclear power debate has illustrated, then, the extent to which the type of knowledge which is employed in the debate departs from the ideal required by technocratic rationality. It has provided examples of the way in which the scientific knowledge (particularly of social phenomena) required as a basis for the planning of future social and technological developments derives from theoretical and conceptual frameworks which are not empirically falsifiable, and necessarily involves the employment of interpretation, judgement and assumptions which are open to heavy conditioning by normative stances in relation to the perceived characteristics of such developments. Therefore, the process of consideration of alternative means to the solution of the energy problem as perceived cannot be made to conform to the model of technocratic rationality. However, there is another part to this aspect of the critique and this concerns the way in which evaluative themes actually condition the consideration of alternative means; it is to this problem that we can now turn.

#### 9.4.3 On the Potential for Demand-Side Solutions

It was argued, in section 9.3 above, that the dominant conception of the energy problem reflects the normative commitments of 'materialism' and 'liberalism' and that such commitments are effectively placed beyond 'rational' discussion by the imperatives of technocratic rationality.

It was suggested that the definition of the energy problem in a particular form affects the process of the consideration of means to its solution; in particular, the supply-oriented conception of the problem can be seen as circumscribing the extent to which 'demand-side' solutions can be seriously considered. This value-conditioned circumscription at the stage of problem definition implies that the process of consideration of means to the solution of the energy problem will tend to be dominated by assessments of alternative supply options. In this section, then, I shall attempt to provide a rather more detailed consideration of the way in which dominant ideological themes circumscribe demand-side approaches.

In many arguments in support of nuclear power there is a rather consistent line of reasoning from 'problem definition' through to 'solution'. As an example, it is possible to quote Greenhalgh's summary of his argument in his book 'The Necessity for Nuclear Power':

"(T)he inevitable growth of world population, together with the desire of the major part of that population which lives in developing countries to have a higher standard of living, approaching more closely that of developed countries, will push world energy demand to between two to three times the present level by the year 2000 - a short twenty years away. To meet this demand by that time the only substantial energy sources are oil, coal and nuclear power. Oil and gas output is unlikely to rise much, if at all, above present levels and could even fall. There must then be a greater reliance on coal. Coal production could be expanded, but it will take time to establish new mines and in particular the new international coal trade that will be required for coal to make a much larger contribution to world energy needs. Coal will be increasingly used as a source of hydrocarbon fuel to substitute for oil leaving uranium to take over as the main primary fuel for electricity generation, and in the longer term for the production of hydrogen. Nuclear power will also be used as a source of heat. Those countries in a position to utilise nuclear energy should then increase their programmes to the greatest extent possible to reduce the present dependence on oil and relieve the pressures on oil supply. And experience shows that nuclear power is cheaper, safer, and less environmentally polluting than most other sources of energy."  
(Greenhalgh 1980 p237).

This general argument can be seen as broadly characterising the dominant energy 'policy paradigm' and a general 'model' of the position can be

represented schematically as in Figure 9.2. The structure of this argument is such that the question of demand-side approaches to the formulation of energy policy is basically settled in the definition of the energy problem. Therefore, the problem is perceived and formulated in such a way that the stage of consideration of alternative means to its solution is concerned almost exclusively with questions relating to alternative options for energy supply. As regards the Government's approach to energy policy, this supply-side emphasis is explained in terms of the sheer practical difficulties of involvement in decisions about energy use:

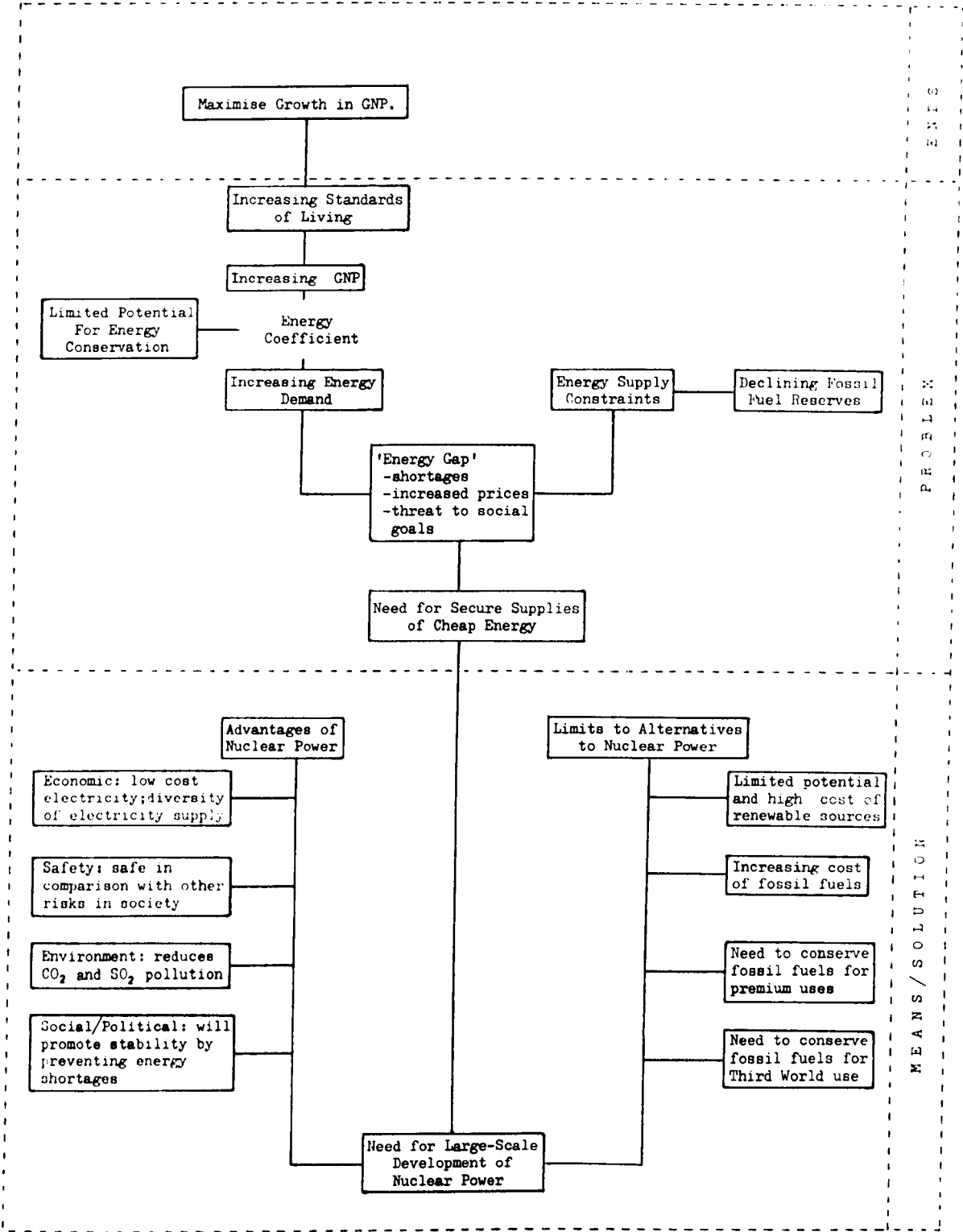
"In considering who makes decisions on the use of resources in the energy sector, one must recognise the inevitable asymmetry which derives from the fact that there are a relatively small number of fuel producers, and very few types of fuel, while there are an enormous number of fuel users, whose patterns of fuel consumption vary widely, and whose uses for fuel differ. This basic asymmetry must influence how government sees its proper role in regard to supply and use investment. It is both because of the uncertainties, and the range of decisions to be taken on the use side, that it is difficult to find an economic justification for direct government involvement in the fuel use choices made by consumers."

(Department of Energy 1983 para 82).

The central question for us, then, is to what extent is this 'asymmetry' indeed due to practical and cognitive problems or, alternatively, what role is played by evaluative factors?

It is possible to identify two main perspectives on the approach to establishing policies in relation to the demand side of the energy equation. The first approach basically involves the assessment of how social goals and needs might be met with the minimum of energy (and other resources) supplied in the most effective way for each defined task. In other words the focus is on ensuring that end-use needs are provided for with maximum efficiency in energy terms; therefore, this perspective can be called the 'energy efficiency approach' (cf Lovins 1977, 1979B;

FIGURE 9.2 A Schematic Illustration of A 'Model' Argument for Nuclear Power.





Leach et al 1979). On the other hand the second approach is primarily concerned with measures to facilitate response by energy users to trends in energy markets and thereby to promote the process of factor substitution in line with changes in relative costs and to ensure the optimal employment of all factors of production. The focus here, therefore, is on ensuring that energy<sup>is</sup> used with maximum efficiency in economic terms and this perspective can be referred to as the 'economic efficiency approach' (cf Department of Energy 1983; Eden et al 1981; Brookes 1983).

These perspectives, then, produce rather different perceptions of what is involved in 'energy conservation' and of the appropriate policies which might be implemented to be consistent with the wider definition of the problem. The 'energy efficiency' perspective implies a relatively important role for government in ensuring that end-use efficiency is increased. Essentially, this is seen as involving the establishment of an institutional framework more appropriate to the achievement of energy-efficiency goals by, for example, correcting institutional barriers which presently impede conservation and 'rational' supply technologies, removing any subsidies to energy supply industries, enforcing energy consumption targets and standards for building, vehicles and appliances, and making energy prices consistent with long-run replacement costs (Lovins 1977 p18-20; Leach et al 1979 p16-17). On the other hand, the 'economic efficiency' perspective implies a minimal role for government in relation to energy use decisions and an emphasis on ensuring the 'realistic' pricing of energy based on market pressures on costs of supply, backed up by certain measures to alleviate the problem of imperfect information, so that consumers' decisions made with reference to such prices will result in an optimum allocation of resources (Department of Energy 1982, 1983).

The dominant energy 'policy paradigm', as was argued in section 9.3 above, incorporates the 'economic efficiency' perspective. On the basis of this position the 'energy efficiency' perspective is rejected on various grounds. Firstly, to the extent that it results in reflection back on the nature of existing social goals and values and in questioning of the nature and composition of 'social welfare' then, within the programme of technocratic rationality, it is associated with 'irrational' and 'emotional' considerations which can be allowed no part in the process of 'rational' and 'efficient' debate and decision making (cf section 9.2 above). Secondly, from the 'economic efficiency' perspective the search for energy efficiency is seen as essentially irrelevant and as leading to patterns of resource use which are economically sub-optimal and therefore inefficient and wasteful. For example, investment in energy efficiency (substituting capital for energy) is seen as occurring at the expense of investment which would promote the complementary employment of energy and capital in a process of increasing overall factor productivities, and investment of capital where it will obtain the highest rate of return (and therefore promote economic efficiency) may adversely affect energy efficiency (cf Brookes 1983 p10-16; Department of Energy 1983 paras 4-17). Behind this argument lie the assumption of the rationality of consumer behaviour, and the value judgements that individual preferences are to count and that social welfare is to be defined in terms of goods and services which are exchangeable in the market.

Thirdly, the 'energy efficiency' approach is to be rejected because the measures required by government to ensure increases in end-use efficiency and the availability of supplies of energy in the most effective forms are seen by some as constituting an infringement of the 'freedom of choice' of consumers and as representing an undesirable trend toward a 'dirigiste' economy (cf Greenhalgh 1980 p3; Weeks 1982 p13; see also Bickerstaffe 1979 p13).

Therefore, the 'energy efficiency' approach is rejected on the grounds of introducing 'irrational' considerations into the debate, resulting in economic inefficiency and therefore reductions in social welfare, and producing undesirable social and political implications. On the contrary, the 'economic efficiency' approach is presented as providing a rational, value-free decision matrix which results in maximisation of social welfare and retains freedom of choice. However, within this approach demand-side policies are not considered to be primary appropriate means to the solution of the energy problem. Rationality and value-freedom are here seen to be consistent with certain assumptions relating to the behaviour of individual consumers and the composition of social welfare which lead essentially to the treatment of the demand-side as a 'black box' and to a primary concern with setting the price of energy in such a way that this 'black box' can be assumed to produce an optimal pattern of energy use.

The conception of optimal resource allocation contained within the 'economic efficiency' approach is based upon a set of value judgements which are in evidence in the normative themes of liberalism and materialism as we have identified them. This evaluative basis is traditionally defined within welfare economics as comprising the 'Paretian' value judgements. Basically, there are four such judgements involved in the definition of 'Pareto optimality': firstly that we should be concerned with the welfare of individuals rather than groups or classes; secondly, that the individuals' utility should be defined in terms of goods and services exchangeable in the market; thirdly, that the individual should be considered to be the best judge of her/his own welfare (ie individual preferences are to count); and, fourthly, that a change in the allocation of resources which results in a 'ceteris paribus' increase in one individual's welfare should be seen as increasing social welfare (Nath 1969 p8-9; Graaf 1967 p143).

Now, this evaluative basis has tended to become taken for granted as 'self-evident' on the grounds that it is widely accepted as a foundation for the definition of optimality; therefore, the establishment of Pareto-optimum conditions is widely seen as a value-free process (Nath op cit p126-30). However, as Weber (1949 p13, 22-3, 44) argued, and as has been pointed out by critics of welfare economics, the widespread acceptance of value judgements and their resulting apparent self-evidence can never constitute grounds for their elevation into moral imperatives or for the assumption that analysis founded upon their acceptance can be asserted as 'value-free' (cf Nath op cit; Pearce and Nash 1981 Chapter 2). Consequently, such an assertion by the 'economic efficiency' approach must be rejected and can indeed be seen as concealing the implicit acceptance of the prevailing values of the status quo.

The implications of this position can be illustrated by referring again to certain of the criticism which are made of the 'energy efficiency' approach from the standpoint of the 'economic efficiency' perspective. For example, in a discussion of the problems of determining the scope for energy conservation, Lecomber (1979 p188-9) refers to the value judgements which are made by proponents of the 'energy efficiency' approach in rejecting ... "the evidence of consumer choice." Specifically, he argues that in overriding the principle of revealed consumer preference such proponents are making value judgements which reject or devalue the welfare losses arising from the consumption foregone due to energy efficiency considerations (eg the switch from a larger to a smaller car). Clearly, value judgements are being made in such cases but there is an implication that to accept the 'evidence' of consumer preferences as indicative of a desirable state of affairs, or as an input to decision-making, does not involve value judgements; this is not tenable.

This implication is also in evidence in the argument presented by Brookes (1983) which was considered above (cf p427). He argues that improved

efficiency of energy use occurs as part of the 'onward march of technical progress' which involves the improved efficiency of the whole productive process, and that such trends are promoted by the availability of cheap energy. Any extra energy conservation over and above this trend must be associated with higher prices; but high energy prices will cause economic growth to be constrained which in turn will reduce the rate of capital investment and technical change and therefore reduce the rate of 'normal' improvement in energy efficiency (ibid p10-15, 32-3). Moreover, he argues that the conservation response to high prices will result in a welfare loss to the extent that resources are directed into investment in energy saving measures ('regrettables') at the expense of the production of other goods and services which consumers 'would prefer'. The allegedly value-free nature of this argument therefore asserts not only the basic Paretian value judgements but also additional judgements concerning the relative weights of different goods and services in the social welfare function.

In the Department of Energy's analysis of the potential for government action to promote energy conservation the emphasis tends to be placed upon certain 'practical' and institutional problems which are seen as prejudicing the ability of government to implement effective demand-side policies (Department of Energy 1983). For example, in considering the question as to whether the government should attempt to redirect investment to energy conservation in order to achieve greater optimality in the allocation of resources considerable emphasis is placed upon the lack of knowledge about the circumstances and needs of an 'enormous number' of individual consumers on the one hand, and about likely future trends in energy prices and market responses, in rates of economic growth and technological change, in industrial structure, in exchange rates and so on (ibid para 77-81):

"The reality is, of course, that we live in a highly uncertain world and none of these factors is known. Decision makers have to form their own judgement on these. Some will be right but most, to some extent at least, will be wrong on one or more of these factors." (ibid para 78).

It is argued, then, that the consequence of such uncertainty and risk is that it is very difficult to form ... "judgement as to the 'appropriate' balance" ... between investment in conservation and supply and that it is ... "not clear that the appropriate fuel mix and thermal efficiencies for consumers in the private sector can either be determined, or effectively imposed, by government." (ibid paras 77, 80). The conclusion from this is firmly stated:

"Without such prior knowledge, it would be impossible to devise an optimal investment allocation both as between supply and use and between projects on each side of the energy scene." (ibid para 77).

The policy implications of this argument are then drawn out:

"It is both because of the uncertainties, and the range of decisions to be taken on the use side, that it is difficult to find an economic justification for direct government involvement in the fuel use choices made by consumers." (ibid para 82).

Moreover, such involvement is equated with certain characteristics of a 'centrally-planned economy' (eg licences, directives, grants, subsidies, exhortations) and is seen as implying substantial administrative cost and 'interference' (eg form-filling, monitoring) (ibid para 94). It is then concluded that:

"Government is not organised to do this. It is not a national entrepreneur making all investment decisions on grounds of minimising costs or optimising resource allocation. Rather it is organised on the basis that decisions are best left, wherever possible, to be made by those who obtain the benefits or suffer the consequences if things go wrong. Underlying this approach is the presumption that for the most part, individual decision makers appreciate their own circumstances, are rational and know better than government what their interest are; and also that decisions made independently of

one another and at different times are a securer answer to uncertainty than a small number of massive centralised decisions in concentrated time periods." (ibid para 95).

Now, certain comments can be made about this argument. Firstly, the problem of lack of knowledge and uncertainty is indeed serious, as discussed in the previous section; and it can be agreed that the problem is rather more severe in relation to the demand-side than in relation to the supply-side. However, this problem is present in all forms of decision-making about social and technological futures and the approach that is adopted to such decision-making cannot be justified with reference to the existence of a firm cognitive basis. Conversely it is difficult to see how the lack of such a firm basis can be logically invoked to justify non-involvement, in this case, in the demand-side when it is recognised that decision-making on the supply-side is also subject to many uncertainties. Moreover, the argument appears to imply that since optimal resource allocation cannot be achieved by 'interference' in the demand-side then government should not be involved at all in influencing energy use decisions; however, the same grounds could be invoked for not making supply decisions. Therefore, this aspect of the rationale for government non-involvement in energy use decisions would appear to be logically suspect; it can be seen as providing grounds for arguments about the appropriate form of involvement in such decisions but not in itself as providing grounds for total non-involvement.

A second important feature of the argument concerns its emphasis on the problem of identifying the circumstances and needs of an 'enormous number' of individual consumers in the private sector (cf 'millions of consumers': Department of Energy 1982 para 6). Again, this is a problem which prejudices the success of demand-side policies, but this perspective neglects the extent to which the level and structure of energy use is influenced by decisions which are not made by the individual as an

'isolated free agent' but rather by, for example, public sector agencies. This problem is emphasized by Goode et al (1980 p24-6) who argue that 'social decisions' in respect of, for example, settlement patterns and transport systems, the pattern and standard of building design, the mix of industry and energy pricing, have a significant impact on energy demand, in some cases a dominant impact. Therefore, it is argued that many important decisions which affect energy use are made within the sphere of government influence and that this constitutes a basis for a strong conservation policy. This criticism of the Department of Energy's argument was also made at the Sizewell B Public Inquiry where it was pointed out, for example, that half the country's building stock is in the public sector (Transcripts Day 43 p23-6). In view of the above comments, then, it would appear that there is rather more behind the Government's stance on energy conservation policy than the practicalities upon which so much emphasis is placed. Indeed, the normative basis for the stance becomes evident in the final quotation presented above (p.451-2; cf Department of Energy 1983 para 95). Here the standard Paretian value judgement relating to the preferences of rational individual consumers is supplemented by a judgement on the 'appropriate' role of government which reflects the 'liberalist' theme of democratic political theory as discussed in Chapter 6. Therefore, demand-side approaches tend to be 'written out' of the discussion about energy policy alternatives simply by adherence to a particular value-position. Moreover, since such values play a major role in the process of problem perception and definition it is at this stage where the 'writing out' begins. The problem as defined and put forward for solution embodies a particular view about the appropriateness of, and potential for, demand-side action which circumscribes subsequent consideration of alternative means. In a sense, then, a 'territory of rationality' is mapped out for the process of considering alternative means and demand-side action is virtually excluded from this territory. The exclusion arises as the implication of the



adherence to a particular value position but the dominant energy 'policy paradigm' presents its approach to conservation as resulting from the pursuit of value-free rationality and efficiency. Such is the ideological programme of technocratic rationality.

#### 9.4.4 On the Evaluation of Costs and Benefits

Potential difficulties arise for the programme of technocratic rationality from any requirement to explicitly trade off the perceived costs and benefits of alternative energy policies. As indicated in section 9.1 above, this requirement takes the debate into the realm of 'evaluative trade-off disputes' and, according to technocratic rationality, such disputes can be conducted only with reference to 'irrational' considerations. From this point of view, then, in the interests of 'efficiency' and 'rationality', the role of such evaluative trade-off considerations must be minimised. In relation to this evaluation problem two possible strategies emerge for improving the 'rationality' of the decision-making process. Firstly, it is possible to attempt to prevent the debate from moving into this realm of irrationality by, for example, arguing for positions in the cognitive dimension of the debate such that the level of perceived costs is 'negligible' in relation to the benefits and therefore such that it can be argued that no 'reasonable' person would invoke a trade-off dispute. Secondly, it is possible to attempt to impose upon the debate about such trade offs, once they arise, some form of 'method' or 'calculus' which can be presented as increasing the degree of rationality in the debate.

It is possible to perceive the development of both these forms of strategy in public policy-making processes. The second strategy is perhaps best illustrated by the widespread employment of cost-benefit analysis as a set

of decision-making rules with universal application which provided for rational decision-making on the basis of precise, quantified implications (Pearce and Nash 1981 Chapter 1). Of course, this type of cost-benefit analysis has been severely criticised on the grounds, for example, of inappropriate quantification, exclusion of 'intangible' items, and imposing a set of value judgements (ie those of Paretian welfare economics) in the attempt to apply a universally-applicable quantitative framework of an allegedly value-free nature (ibid; cf Self 1975). Consequently, the value-contingent nature of cost-benefit analysis is now more widely recognised and there has been a considerable effort made to develop alternative techniques in order to promote the rationality of decision-making (eg goals-achievement matrices, multiple criteria optimisation techniques etc). This effort can be seen as consistent with the programme of technocratic rationality conceived, in this respect, by Habermas (1976A p341-2) as involving the attempt to impose rationality on the separated domain of values and norms through a 'positivistic' decision theory which applies such criteria as 'economy' and 'efficiency' to the form of decisions but neglects consideration of content (ie the actual nature of the values involved).

However, in spite of efforts to develop such formal decision-making techniques the realm of evaluation and trade-off remains subject to considerable controversy. Consequently, the imperatives of technocratic rationality are best served if explicit reference to this realm can be avoided. There are two components to such an avoidance strategy as it relates to the nuclear power debate. Firstly, as indicated above, it involves arguing in the cognitive dimension that the implications of nuclear power development are such that there are no significant costs to be traded against benefits (cf the 'unconditional support' position identified in section 9.1). However, there is an additional possible component and this involves the invocation of 'normally accepted'

conditions in other areas of social life to justify particular levels of costs without explicit reference to evaluative considerations. This latter component can therefore be seen as an important element in the process whereby decisions are increasingly taken out of the explicitly political realm and presented as the outcome of technical processes in which a particular set of values is implied under the guise of value-freedom.

As an illustration we can refer to the use of the concept of 'acceptable risk' in relation to the potential hazards of reactor emissions and accidental radiation releases. As Pearce (1980B p8) points out, there are two possible approaches to the definition of 'acceptable risk', the first involving reference to other risks which can be considered to be 'acceptable', and the second involving explicit reference to the benefits against which the risk is to be traded. Taking the arguments in support of nuclear power it is evident that the first approach predominates. Otway and Von Winterfeldt (1982 p249-50) summarise the procedure:

"Having arrived at a quantitative estimate of risk, some analysts then compare it with statistics reflecting society's experience of more familiar risks of technological or natural origin, assuming that physical risk, as accepted in the past, provides sufficient information to judge the acceptability of a new technology today. These comparisons are offered as a basis for judging the social acceptability of the new risk by placing it 'in perspective' as a preliminary to 'embedding the problem into the normal conditions of life'."

The process of 'embedding' (as indicated in Chapter 8) has been advocated by Häfele (1974 p308-12) arguing that we must have some standard or yardstick against which to judge acceptability, and that the appropriate yardstick is the 'normal conditions of life' into which, therefore, the problem should be 'embedded'. Lord Rothschild has endorsed this procedure and advocated that a general standard of acceptability be derived from the risk of being killed in car accidents in the UK (Otway and Von Winterfeldt

op cit; Bickerstaffe and Pearce 1980 p319). The practice of portraying the risks of nuclear reactor accidents as acceptable with reference to other risks of life is widespread in arguments for nuclear power (cf Greenhalgh 1980 p174-86; Hill 1981B p3; Wade 1981 p298; see above Chapter 8).

A recent example of this practice is provided by the CEEB's case for the Sizewell B PWR. The CEEB's 'design safety criteria' for reactor accidents are targets which are set ... "with regard to the levels of risk perceived in other fields of life." (CEEB 1982A p81-3; Matthews 1982 p34-7). It is argued that:

"It has always been the endeavour of the nuclear industry to ensure that risks from nuclear plant are lower than the everyday risks of life that currently exist and can be compared favourably with other risks for similar types of activity. There is no generally acceptable level of risk but different authorities have put forward views on the acceptability of various levels of risk." (ibid para 98).

A general standard of acceptable risk is then derived on the basis of certain 'authoritative views' including the ICRP, Royal Commission on Environmental Pollution, the Health and Safety Commission's Advisory Committee on Major Hazards and Lord Ashby. The latter's argument goes as follows:

"Some sort of scale of relative values attached to risks is emerging as a rule of thumb for political decisions .... As a very rough generalisation it can be said that risks of one in a million are of no concern to the average person." (quoted in Matthews ibid para 102).

Similarly, for the development of a system of radiological protection the CEEB follows ICRP recommendations for judging the acceptability of risks to radiation workers and members of the public. For the former the standard is the risk for ... "other occupations recognised as having high safety standards"....; while for the public acceptability is judged ... "in

the light of the public acceptance of other risks of everyday life."  
(CEGB 1982A para 13.22-23).

The practice of 'risk embedding', then, results in a portrayal of the risks of nuclear power, as expressed in design targets, as being generally acceptable and of little concern in relation to 'normal' conditions of life. By implication the risk is negligible and therefore, no rational person would attempt to invoke a trade off against benefits which would require a valuation of the risk (cf Little 1983 p56-9). 'Embedding' therefore provides a means of avoiding this process of explicit trade off which would involve the development of 'evaluative trade-off disputes' and hence, within the terms of technocratic rationality, jeopardise the rationality of the debate.

However, this practice is open to criticism on various grounds. Firstly, there is the question of the appropriateness of comparisons between different risks given their different nature and the ambiguity in the concept of 'risk' itself; risks may be voluntary or involuntary, they may be low probability/high consequence or high probability/low consequence, and different indicators might be available to measure categories of risk (Pearce 1980B p8; Bickerstaffe and Pearce 1980 p319). Secondly, a problem arises because the risks calculated for nuclear reactors are design targets to be achieved in practice whereas the 'risks of everyday life' used for comparison are frequency outcomes based on past experience. Consequently, like is not being compared with like since there must be some additional probability of the targets for nuclear reactor performance not being achieved in practice which is not being taken into account.

More fundamentally, there is the question of the grounds upon which the comparative risks of everyday life are judged to be 'acceptable'. This

problem is perhaps indicated in the subtle shift which occurs between the proposition that certain 'risks of everyday life' are accepted, to the proposition that these risks are acceptable in a general sense. The first problem concerns who is to be the judge of whether or not such risks are widely accepted and what degree of public acceptance (given at least some degree of dissent), assessed in what way, can provide grounds for this conclusion. It could be asked, for example, how the rather vague generalisations about risk acceptance by the 'general public' which underlie the conclusions of the bodies referred to by the CEEB for standards of acceptability, can constitute an 'authoritative' basis for such standards (cf Matthews 1982 p37-40; CEEB 1982A para 14.43).

However, it is the translation from a risk which might be accepted in a particular context to a risk which is generally acceptable which constitutes the major problem. For a risk which is considered to be non-negligible, acceptance of it is basically motivated either by the benefits against which it can be traded or by an assessment of the social costs which would be incurred in reducing it (cf Bonnell 1982 para 38). Therefore, the acceptance of a particular risk in a particular situation with reference to these considerations cannot be taken as evidence of the acceptability of that level of risk in a general sense. For example, if it could be argued that the general public in this country accept the risk of being killed in a car accident (which is debatable because many people do not accept it) then this acceptance must be related to the benefits which accrue from car ownership and use on the one hand, and the costs which would be incurred in reducing the risk on the other. In other words the acceptance is context dependent and makes explicit reference to the valuation of costs and benefits: it is a value-conditioned judgement. It cannot then be asserted that this risk of death in a car accident is in some way generally acceptable beyond the context in which its acceptance is judged, ie without reference to benefits or costs of

This assertion is, however, central to the practice of 'risk embedding'. Risk targets for nuclear reactors are justified as acceptable with reference to general statements of acceptability which are abstracted from the context of value judgement which provides them with meaning. In effect, such risk targets are being justified 'by the back door'; they should only be justified with reference to the perceived benefits of nuclear power as assessed in an explicitly evaluative context. There is no conceivable basis for justifying such risk targets with implicit reference to the benefits of other technological developments, the social costs of reducing other risks or the acceptance of the risks from 'natural disasters'. The attempt to establish acceptability in these terms through 'embedding', allegedly in the interests of promoting rational debate and decision-making processes, merely serves to 'de-politicise' such processes by side-stepping discussions of social ends and values in the context of a trade off between risks and benefits and, more generally, by promoting a concept of universally-acceptable levels of risk which can be used to justify social and technological developments in a supposedly value-free calculus. As a result existing dominant values are effectively shielded from challenges which would arise if the focus was placed upon the normative implications of risk acceptance and the process of justifying risks with explicit reference to the benefits against which they could be traded.

Nevertheless, this latter approach to the determination of 'acceptable risks' does have its problems. It has the advantage of potentially making value choices and assumptions more explicit but in the form of 'risk-benefit analysis' becomes susceptible to the tendencies, discussed at the beginning of this section, to mould such decision-making aids into quantitative 'techniques' of universal applicability, as has been the case with cost-benefit analysis. Thus, when it comes to the problem of expressing benefits and risks in commensurable units, the

ready expressibility of economic benefits in money terms leads to the search for a monetary valuation of risk and this involves calculating a money value for human life. Some regard this as morally offensive but Pearce (1980B p11) justifies it in the following terms:

"(A)ny decision implies a value of human life and that alone is sufficient for us to justify converting the disutility function into a cost-of-risk function using whatever values are separately determined to apply."

However, the danger is that the decision-making process can be reduced to an apparently unambiguous and objective problem of calculating a simple quantitative risk-benefit ratio which submerges and obscures the value choices which are required. The process of estimating the 'value' of human life is an essentially ethical one but the search for quantification can hide this and lead to the implicit acceptance of certain ethical 'norms'. Moreover, if such money valuations are determined separately from the decision-making process in which they are to be used, then the ethical choices upon which the valuations rest are effectively 'written out' of the decision in question - they are not open to scrutiny or challenge. Finally, in a quantitative risk-benefit analysis problems of values and ethics are essentially reduced to the problem of deriving numerical 'weights' for quantified risks and benefits and it can be argued that such quantification tends to 'anaesthetize' the ethical dimension by requiring a 'gestalt shift' which results in a failure to address the full complexity of the ethical problem.

Therefore, although in principle there are advantages in the definition of acceptable risks in relation to the associated 'benefits', in practice, in the form of risk-benefit analysis, several problems arise. In effect, the crucial ethical and value choices become submerged and implied in the drive for quantification and this tends to 'impose-by-default'



prevailing values and ethical norms. The result is that risk-benefit analysis is reduced to merely a more sophisticated form of 'risk embedding' in which the value framework of the analysis is effectively derived implicitly from a particular interpretation of the 'normal conditions of life' in which risks are incurred in the pursuit of the prevailing goal of material economic growth. The business of risk evaluation can therefore be seen as serving to establish a framework for the justification of incurring risks in the pursuit of existing dominant social goals and values without requiring explicit discussion of the ethical issues involved on the grounds that this latter activity can be no part of a 'rational' decision-making process.

#### 9.4.5 Conclusion

In this section, then, I have attempted to illustrate some of the fundamental problems in the conception of 'rational' and 'efficient' debate and decision making which is propounded in what I have identified as a dominant ideology of technocratic rationality. Basically, the central argument has been that this ideal of rationality is founded upon an untenable conception of the nature of the knowledge which it is possible to develop in the debate about nuclear power. Such knowledge is often of a highly tentative and speculative nature, heavily influenced by value-conditioned judgements and assumptions, and cannot support the claims and imperatives which, we have seen, are frequently propounded in the debate. If this argument about the nature of knowledge is conceded then it becomes illegitimate to dismiss oppositional arguments simply on the grounds that they dispute certain 'facts' because all 'facts' are open to debate in this context. This is not to argue against the importance of high standards of scientific practice and discussion; these are indeed crucial. Rather, it is to argue that even with the

development and application of the best possible practice in this respect there will still be dispute over the 'facts' of the nuclear power debate and that such dispute will not be due to 'irrational' behaviour by some but rather due to the irreducible 'ambiguity' of the phenomena with which the debate is concerned compounded by the divergencies between values and interests which are a central feature of our society. To invoke the imperatives of technocratic rationality, then, is to promote a particular set of values by imposing a value framework upon the debate which must be taken as given if 'rationality' and 'efficiency' are to be achieved.

I have also attempted to illustrate the extent to which this ideal of rational and efficient decision making is jeopardised by the way in which the consideration of alternative means is circumscribed by a value-contingent definition of the energy problem. Specifically, the virtual 'writing out' of demand-side approaches can be seen to be founded upon the 'taking-for-granted' of a particular value framework. Again, this value-conditioning of the process of debate and decision-making indicates the infeasibility of the imperatives of technocratic rationality and further illustrates its ideological nature.

Finally, I have attempted to indicate some ways in which the problem of evaluation is accommodated in this model of rational decision making with reference to the evaluation of risk. Essentially, I argued that since the process of trading off costs and benefits in relation to goals is considered to be part of the realm of the 'irrational', then considerable attempts are made either to avoid this process or to attempt to subject it to 'rational' procedures. The first strategy involves arguing that the costs of nuclear power are negligible and, additionally, involves the attempt to present such costs as generally 'acceptable' without explicit reference to the normative basis underlying the defini-

tion of 'acceptability'. The second strategy involves moulding the evaluation process into a formal, quantitative decision-making 'technique' which serves to defuse the dispute over values by imposing implicit value choices in the guise of 'value-freedom' - the central feature of this ideology of 'rationality'.

#### 9.5 In Conclusion: Some Political Implications

In this Chapter, then, I have approached the analysis of the debate about nuclear power from a perspective founded in the conceptual framework developed in Part One of this thesis. My two major concerns have been, firstly, to provide an indication of the extent to which this debate is inserted into the themes and discourse of a dominant framework of ideological knowledge and, secondly, to illustrate some of the fundamental problems in the conception of 'rational' policy making (and therefore in the implied imperatives) contained in this framework. This has led to the discussion of certain implications for the energy policy-making process.

In particular, I have argued that technocratic rationality serves to produce an approach to debate and decision making in which particular dominant ends and values are implicitly taken for granted and, effectively removed from the possibility of questioning on rational grounds, become elevated into ethical imperatives. Since such values condition the perception and definition of the energy problem and thereby circumscribe the policy-making process, technocratic rationality serves to conceal such conditioning of the dominant energy 'policy paradigm' behind a facade of 'efficiency' and 'rationality'; the promotion of dominant values proceeds in the name of value-freedom.

More specifically, I have attempted to indicate the ways in which dominant evaluative themes of 'materialism' and 'liberalism' influence perceptions of the energy problem and appropriate means to its solution so as to promote a pervading orientation towards resource-intensive economic expansion in which increasing energy consumption becomes synonymous with modernity, a consequent preoccupation with ensuring supplies of energy to guarantee continued consumption and growth, and a resulting neglect of issues and questions concerning the demand for energy. Indeed, demand-side approaches are essentially 'written out' at the level of problem definition and the conception of the problem in terms of an imperative to provide secure supplies of energy into the long term future ('driven' by a materialist ethical imperative) produces a particular orientation towards the consideration of alternative means.

Thus, the present structure of demand tends to be seen as unproblematic within the framework of neo-classical economic theory, representing the outcome of market decisions of consumers behaving rationally in accordance with their subjective preferences in relation to market prices. The problem, then, is seen as one of getting prices 'right'; it is assumed that the market will then bring about optimum allocations. Questions about the extent to which current and projected demands are related to assessments of 'needs'; about the suitability of different forms of energy in relation to end-use characteristics; about possible definitions of 'waste' in conversion; about the extent to which economic growth could be maintained with reduced energy consumption; and, more fundamentally, about possible alternative paths of future social development - such questions are either neglected or outlawed as illegitimate within the confines of rationality.

On the other hand, given declining reserves of fossil fuels and perceived uncertainties and problems of energy-intensity in renewable sources, an

overwhelming emphasis on nuclear power as a 'secure' means of providing long-term, large-scale supplies of energy can be seen as almost a concomitant of the normative basis of the dominant energy 'policy paradigm'. The argument that such an emphasis is the necessary result of an impartial consideration of the available 'facts' can therefore be seen as embodying the ideological nature of technocratic rationality.

Within our conceptual framework, then, these dominant ideological themes operate 'positively' to condition the policy-making process. However, such themes can also be seen to operate in a 'negative' way. In particular, technocratic rationality produces a conception of policy-making which apparently can be 'above' the traditional realm of political activity which is portrayed as irrational. The ideal of such activity is the model of rational technocratic guidance in which means to given ends are assessed in relation to objective scientific knowledge dispensed by impartial experts. To the extent, then, that the operation of political power remains an important influence on policy making, the technocratic conception serves to conceal such influence behind its facade of rationality and value-freedom, and therefore to legitimise existing structures of political power.

This 'negative' aspect of ideological influences on public policy making can be of considerable importance. Essentially, the form of 'rationalism' embodied in technocratic rationality generates a 'technical' framework for the discussion of policy issues which abstracts from power political influences on the one hand, as well as promoting particular normative themes on the other. Such positive and negative aspects interrelate to constitute a complex set of ideological influences on policy making. It is beyond the scope of this study to attempt to assess the relative importance of ideological and power political influences on policy-making; my concern has been primarily to attempt to indicate the nature and role

of the former. However, the question of this interrelationship is clearly an important research issue particularly in view of the way in which technocratic rationality tends to 'write out' power political influences from analytical attention by excluding them from the realm of rationality in its normative model of policy making.

The legitimacy nature of the knowledge applied in the dominant energy 'policy paradigm' in relation to existing structures of political power has, indeed, been referred to by Lindberg (1977) in the context of an analysis of an apparent lack of responsiveness in energy policy-making systems to the so-called energy crisis of the early 1970s. In a comparative study of such responsiveness in several advanced industrial societies, Lindberg found their policy-making systems to be dominated by "...a relatively small, stable and closed circle of organisational elites..." (ibid p333) mainly associated with the production of energy. Such elites, he argued, supported by technical experts, tend to restrict decision making to supply-oriented perspectives, evoking support from such criteria as the 'national interest', 'progress', etc. Further, as a consequence of such elite domination, decision making tends to be fragmented and incoherent, with complex decisions divided into simpler components thus circumventing the problem of integration and trade-off of competing values and insulating decision-makers from democratic control (ibid p333-7).

More generally, Lindberg sees the political structure of growth- and consumption-oriented industrial societies as dominated by three closely-interrelated social institutions. Firstly, with increasing state intervention in economic and social management and planning in such societies complex bureaucracies have arisen which have developed 'dynamically conservative' modes of decision making in response to rapidly-changing, complex and interactive problems. Such modes of decision

making are seen as tending to reinforce a disaggregated, incremental and sectoral approach to policy that implicitly advantages established groups and assumptions and militates against 'higher level value integration' (ibid p340-3). Secondly, a cadre of technocrats and experts operate within such bureaucracies whose skills and expertise, underlain by 'technocratic values', are seen as vital to industrial and economic 'progress', to the power and legitimation of organisational elites, and to the reproduction of basic structures of control (ibid p344-6). Thirdly, Lindberg argues that a set of class structured social relations provides the foundation for the other levels of the political system and that the power and influence of dominant classes and elites is buttressed by ..."social rules and ideologies that, while seldom if ever explicitly contested, structure and limit pluralist competition and the decision range of organizational elites." (ibid p347).

Consequently, within Lindberg's framework ideology plays an important role in conditioning the policy-making process and in legitimising the political power of dominant elites and social forces. Within such a framework, then, it is possible to gain some insight into the potential importance of the 'negative' role of technocratic rationality in terms of the nature of the power political influences on policy-making which are legitimised in its conception of rational policy making. Thus, Lindberg summarizes the implications of his framework as follows:

"Energy policies are supply oriented and dominated by producers' interests; other groups and other criteria challenge them in various ways but with little impact on actual outcomes; governmental bureaucracies are dynamically conservative; and technocratic values increasingly suffuse policy formulation. All of these are consistent with a view of the larger picture in which dominant industrialising elites or social forces in communist and capitalist, developed and developing nations alike struggle to maintain the existing pattern of production, social priorities, and economic expansion, in spite of resource and energy supply constraints in the form of depletion, price increases, or import dependency." (ibid p348).

The corollary of this political implication of technocratic rationality is a tendency towards the restriction of popular, public participation in policy-making. Again, Lindberg summarizes the argument:

"The technocratic 'ethos' assumes the desirability of separating scientific questions from political and social value questions, assumes further that the scientific and technical questions are the more decisive and that they can be resolved on scientific grounds apart from ethical considerations, and finally, by perpetuating the notion that scientific expertise is the main requirement for making reasoned choice among technological alternatives, restricts participation in such decisions and frustrates democratic control of technology." (ibid p344-5).

Finally, there is another important possible political implication of technocratic rationality to which it is worth briefly referring. I argued above (see section 9.3.3) that the notion of rational policy making contained in the technocratic conception implies a tendency towards the translation of existing dominant values from ends which are to be desired into 'ethical imperatives' which must be achieved and which are, as such, beyond discussion on rational grounds. Since the consideration of means to the achievement of such imperatives is seen as a purely 'technical' issue then the problems which might be associated with the implementation of means tend to be conceived of in technical terms and are therefore considered to be susceptible to 'solution' or limitation through the appropriate technical and institutional 'fixes'. However, such 'fixes'<sup>are</sup> presented as 'neutral' measures to limit social costs, themselves devoid of evaluative implications, thus circumscribing the process of evaluation of alternative means. As such the quality of imperative is readily transferred from ends to the appropriate 'fixes' once a particular means emerges from this circumscribed evaluation process. This raises the potential problem that in developing the appropriate supposedly neutral 'fixes' to achieve particular values, hypostatized as imperatives, political and institutional structures become subject to change, but this change occurs under the guise of



This implication is indeed identifiable in some arguments presented in favour of nuclear power from a 'technocratic rational' standpoint. For example, Weinberg (1978) argues from a position in which the need for nuclear power is established almost as an imperative with reference to the goal of material economic growth; it is seen as ... "a permanent technological base for man's material well-being..." (ibid p73), an essential option in the 'real world'. Therefore, ... "what is needed are ways to fix nuclear energy..." (ibid p74); an 'acceptable' nuclear future will require an underlying political consensus and this will in turn require the identification and 'fixing' of 'deficiencies' (ibid p76-7). The fixes required are of a technical and institutional/political nature. 'Technical fixes' are required to control proliferation and diversion, to solve problems of waste disposal, and to prevent serious accidents. 'Institutional fixes' will also be needed to solve safety and proliferation problems; this will essentially involve devising ... "better institutional and political arrangements." (ibid p77-8).

Weinberg elaborates on the nature of such arrangements. He argues that ... "we must guarantee some degree of political stability" (ibid p79) and suggests the development of a policy of 'center siting'. The aim of this policy would be to...

"... reduce to a minimum the land committed to nuclear energy and... place the enterprise in the hands of highly expert, professional people invested with institutional longevity. These two fundamental desiderata seemed to us to come together, almost automatically, if nuclear energy were confined to large energy centers. These centers would automatically draw to them powerful groups of people...who could provide the strength in depth that is a prerequisite for successful management of the nuclear enterprise." (ibid p79).

It is apparent that Weinberg presents his proposal in an essentially 'neutral' guise - a technical solution to potential social costs of nuclear power; moreover, it is presented in the form of a virtual

imperative as the reference to 'fundamental desiderata' indicates. The implications of such measures for social and political values are not considered; material well-being is effectively established as an unquestionable goal and the means to its achievement must be implemented as 'efficiently' as possible.

A similar form of argument is presented by Starr (1982). The need for nuclear power is established with reference to an economic growth imperative and it is argued that the main potential problems associated with nuclear energy are amenable to technical solutions. However, while ... "expanded use of uranium power is essential to provide a substantial portion of the electricity necessary for world economic growth"..., obstacles to this expansion derive from ... "the inadequacies of our industrial, political and economic institutions to manage this new energy system effectively..." (ibid p250). Therefore, we must, Starr argues, change our organisations and institutions so as to permit effective and efficient management of nuclear energy programmes by, for example, providing such programmes with their 'own management structure' and promoting multi-national or international management of fuel-cycle plant (ibid p 254-5). In other words ... "industrial nations should thoughtfully plan and establish the unique institutions and management that this special technology demands." (ibid p255). Once again the implication is that wider political and institutional changes are being established as imperatives with reference to a specific domain of technological development and are being placed 'above' the requirement of evaluation in relation to broader political and social values. Therefore, in the name of 'efficiency' and 'rationality', a particular technology, established as 'essential' in relation to particular values, begins to dictate our social and political structures further eroding the potential for democratic control of social and technological development.

In conclusion, then, it can be argued that the themes of the 'technocratic ideology' have an important impact on the processes of debate and decision-making about the future development of nuclear energy. An important manifestation of this impact is in the imposition of a particular set of restrictions and constraints on such processes and in the effective denial of opportunities for meaningful discussion of, or challenge to, such constraints. Strongly conservative influences derive from various factors: analytical neglect within theoretical frameworks of such variables as class, social conflict and institutional change; the promotion of a culture of political passivity, apathy and alienation through scientific and technological elitism and through the 'post political myth' which insists on the desirability and inevitability of the replacement of politics by rational, value-free technocratic guidance; the abstraction of technological development from its social and political context and the banishment of normative questions concerned with values to the realm of irrationality while experts in command of 'hard facts' are given preeminence in the realm of 'rational' discussion. The policy-making process is restricted to issues, problem interpretations and policy prescriptions which present no fundamental threat to established interests; challenges to dominant groups and elites are deflected since the legitimacy of the bases upon which fundamental challenges could be made is denied. Issues such as nuclear power development become insulated from truly democratic political discussion, social development is taken out of the realm of public choice, and any attempt to question the resulting paths of development brings down the charges of 'emotionalism', 'irrationality', questionable or unpatriotic motivation, and even 'fascism'.

## Chapter 10: Conclusion

The aim of the analyses presented in this thesis has been essentially two-fold. In the first place, I have been concerned to undertake an examination of the issue of the 'rationality' of social scientific knowledge and of the role of such knowledge in informing action designed to influence the course of social and technological development. More specifically, I have attempted to formulate a conception of the nature of ideological knowledge in our society and of the form of the normative underpinnings or commitments of a dominant framework of ideological knowledge as it relates to the process of 'societal guidance'. Secondly, I have been concerned to apply this conception in an examination of certain aspects of the debate about nuclear power - specifically, the 'mainstream' arguments in favour of its development - in order to make some assessment of the contribution of such a conception to developing our understanding of this debate.

It is appropriate now to assess the extent to which the analysis has achieved these aims, to indicate its limitations and to discuss various possible directions for further research which become apparent from the analysis to date. As regards the first aim, then, I have, in the first part of this thesis (chapters 2-6), developed in some detail a conception of the rationality of scientific knowledge of social phenomena, of the nature of ideological knowledge, and of a 'dominant ideology' in terms of its major characteristics and normative commitments in relation to the social problem-solving activities of the state. This conception is developed in the form of a 'theoretical-descriptive schema', a set of hypotheses and descriptions derived primarily on the basis of a review of literature from

many schools of thought. An essentially integrative approach was adopted, attempting to identify useful elements in various alternative theoretical perspectives, rather than restricting the analysis within the confines of a particular pre-conceived theoretical framework. From the viewpoint of such frameworks, then, the resulting conception may appear 'eclectic'. However, my view is that such a criticism of eclecticism is usually made from an epistemological standpoint which claims access to the objective truth about the social world; from the alternative standpoint of the present analysis such a claim is seen as ideological.

Nevertheless, serious problems do arise in the assessment of the 'scientific validity' of the conception which I have developed. These problems essentially arise from the rejection of the notion of methodological guarantees of objective knowledge, a rejection which raises problems of relativism and, at the limit, produces Feyerabend's position of 'anything goes'. However, the epistemological position embodied in the conception is not <sup>one</sup> of extreme relativism; indeed, it rejects the view that 'helpless relativism' is the necessary concomitant of a denial of the possibility of methodological guarantees of rationality. Instead, it places the focus on decisions, judgement and integrity of scientists in particular social positions, defined in terms of the nature of the scientific community and its relationship to the wider social and political context. From this perspective, therefore, social knowledge can be assessed in terms of its 'scientific quality', notwithstanding the value-contingency and moral colouring which are necessarily part of its make-up, and the dimension of 'cognitive reliability' is essentially contingent upon the critical judgement and integrity of scientists within the context of their scientific community.

In other words we are going part way along the Weberian and Popperian paths, as discussed in chapter 4, accepting the role of values, defined in a particular socio-cultural context, in the 'psychology of knowledge' but rejecting the notion of methodological guarantees in the 'logic of knowledge'. This distinction is seen as false and the process of social knowledge formation is seen as an essentially 'social-psychological' process. Such a view places considerable emphasis on the role of critical judgement and decision-making by the scientific community: it therefore accepts Ravetz's view of the primacy of 'scientific ethics'. Moreover, it sees such ethics as being intimately related to the socio-cultural and political characteristics of the society in question and therefore posits a relationship between the 'scientific quality' of social knowledge and its social and political context.

I shall return to these issues later in discussion of further research needs but it is perhaps worth summarising briefly my conclusions on the nature of social science. I would conclude, then, that the development of hypothetical statements is thoroughly contingent upon the values of scientists and their community and upon the normative commitments embodied in particular paradigms or world views. The process of testing hypotheses must rely very much on the critical judgement and integrity of the investigator and 'good' social science can be seen as having certain prerequisites: firstly to critically examine as many implications of the hypothesis in relation to as much 'appropriate' empirical evidence as possible (taking into account its limitations as theory-dependent); secondly, to be as explicit as possible about the necessary judgements involved and the values and assumptions underlying them; and, thirdly, to seek the maximum degree of criticism of any conclusions drawn. The process therefore depends heavily on 'craft judgement', guided

by a set of ethics; it cannot produce 'objective truth' but 'scientific quality' ('cognitive validity') can be seen as contingent upon the above criteria.

From this perspective, then, the 'truth' about the social world will always elude us and those who purport to peddle 'truth' must be seen as guilty of deception. Since social knowledge must always have a certain 'moral colouring', disagreements about political and social ends in a society will be reflected in competing versions of 'social reality'. Moreover, in a society with dominant-submissive social relations the requirement of the exercise of power through ideology will produce a tendency for the dominance of a particular set of ideas which can perform a legitimising role in the guise of 'truth'. This implies that in such a social context, the social influences on science and the system of scientific ethics will depart from the ideals outlined above. Furthermore, it implies that the attainment of such ideals must be contingent upon changes in the social context. In this sense, then, we are led to the view that, in essence, a society may get the science that it deserves.

Returning to the question of the 'scientific validity' of the conception developed in this thesis, the implication is that the assessment of such validity basically must involve the elaboration of the implications of the conception in relation to a particular issue (in this case the debate about nuclear power) and making critical judgement and decisions about the extent to which the evidence suggests rejection, modification or acceptance of the conception. This, then, was the second aim of this thesis and the analysis was reported in the second part of the thesis (chapters 7-9). The analysis was, however, necessarily restricted and was confined to an examination of the 'mainstream' arguments in favour of nuclear power

development in terms of the extent to which they embody the normative commitments of what we have conceived of as a 'dominant ideology', and the extent to which they gain credence in the debate from such commitments. In relation to this more limited interpretation of our aim, it was concluded that there is indeed evidence to support the conception in relation to the conduct of the 'nuclear debate'.

However, it must be emphasised that the analyses in this thesis cannot be seen as providing support for the whole of the conceptual scheme as developed in the first part. In particular, evidence to support the influence of the identified normative themes of an hegemonic framework of ideological knowledge does not necessarily lend support to the various other components of the theoretical framework concerning, for example, the role, in the process of social knowledge production, of the 'problem-solving' activities of the state and the specific role of social knowledge, relative to political power, in the process of public policy formulation. These might be seen as receiving some 'indirect' support by virtue of their interrelationship with the more 'directly supported' hypotheses within the wider conceptual framework, to the extent that this framework is internally consistent. Nevertheless, there is a need for further more detailed analysis of the various aspects of the theoretical position elaborated in the first part of the thesis.

As regards possible lines of further research there is indeed a multitude of questions which has been raised by the analyses in this thesis. I shall attempt to cover the more important ones in discussion of three main research areas of increasing 'generality': aspects of the debate about nuclear power; the question of the role of social knowledge in public policy formulation; and the issue of the relationship between the process of knowledge development and its social context.



First, then, there are many aspects of the debate about nuclear power which require further research. In substantive terms, we require an improved understanding of the economic, environmental, social and political implications of nuclear power development. As I have argued, this cannot be a case of producing 'objective truths' about such implications but rather of constantly attempting to improve the 'scientific validity' of our knowledge and produce a context in which alternative and competing perspectives are openly and critically discussed and recognised as scientifically valid to a greater or lesser degree. The problem of bringing about such changes will be discussed below under our third area of research. At this stage it can be suggested that there is a need for more research into those aspects of nuclear energy which are of great concern to its opponents but which do not attract funding from official sources, in order to increase the potential for conflict resolution on the basis of increased knowledge, while recognising that this potential may be rather limited.

Particular areas where further research is needed include the relationship of nuclear power development to economic growth and its wider macro-economic implications, the environmental consequences of large-scale development of nuclear energy, the low-level radiation implications of the nuclear fuel cycle and the effects of this on human and other biological systems, and a fuller and more open assessment and discussion of the implications of nuclear power development for social structures, individual freedoms and the proliferation of nuclear weapons. Another important area concerns the role of the 'nuclear industry' (defined in the widest sense) in our political system and the way in which decisions about nuclear policy are made; this relates to our second area of research below. Finally, the analysis in this thesis has been restricted to the arguments of the supporters of

nuclear power and it is necessary to extend the same approach to the analysis of the arguments of its opponents in order to identify their normative underpinnings and the specific way in which such evaluative factors constitute the basis for conflict.

The question of the role of social scientific knowledge in the public policy-making process and, in particular, in the resolution of conflict over public policy issues has essentially provided the broader context for the analyses presented in this thesis. However, further research is required on various aspects of this question. A useful approach might be to broaden the analysis to look at the wider debate over low energy futures to isolate the sources of the conflicts and identify the potential for conflict resolution on the basis of 'improved' knowledge. A possible approach to extending my analysis into such a research area can be briefly outlined.

The basic research hypothesis would derive from the conclusion of the present analysis to the effect that the perceived 'rationality' and 'acceptability' of arguments concerning the nuclear power issue depends, to a significant extent, on the nature of their underlying normative basis in relation to dominant 'conventional' values and interests. It would be hypothesised, then, that conflict over energy policy issues primarily derives not from problems of shortage of information or the use of wrong information, but rather from the existence of conflicting basic 'evaluatory perceptions' of the social world which are manifested in conflicting paradigms and world-views, and in conflicting social and political value judgements and assumptions embodied in the analyses and proposals of different interest groups. In other words, conflict derives not simply from ignorance but from the material interests of different social groups and classes within a specific institutional context, interests which become embodied in

the aims, motivations and arguments of the various groups entering the energy policy arena.

The process of assessing the validity of this hypothesis would involve the following stages. Firstly, the energy scenarios which have been propounded by interest and pressure groups and official government bodies could be examined to determine the major areas of conflict. The various critiques and reviews would also be examined at this stage. Secondly, the assumptions, postulates, premises, information bases etc upon which conflicting positions are developed could be identified. Examples might be assumptions about economic growth, definitions of economic variables, assumptions about the performance of supply options (efficiencies, accident risks, economic, social and environmental implications etc.). Particular attention would be given to identifying the basis of selectivity and judgement, and relating choices to the theoretical commitments which underlie the development of the scenarios and provide the analytical dimensions of the paradigms within which the scenario proponents are situated.

The third stage might involve an examination of the social, political and institutional 'positions' of scenario advocates, their aims and objectives in relation to the promotion of energy scenarios, and the sets of social values and interests which underlie their approach to the energy policy arena. This would involve analysis of their constitutions and statutory obligations (if any), of any contributions to other areas of public policy and, further, could involve an approach to the groups involved with a structured enquiry into these issues. A basis would therefore be provided in these stages for tracing the source of energy policy conflicts via inter-paradigm disputes to conflicts in social values and interests

as they are manifested in the particular social context of the conflicts.

Finally, the analysis would provide a basis for an assessment of the potential for 'conflict resolution'. On the one hand, the frameworks employed for the analysis and evaluation of energy policy alternatives could be assessed in terms of their existing implications for conflict resolution and their potential for incorporating an explicit consideration of those factors which are at the base of controversies and therefore for contributing to their resolution. On the other hand, it would be necessary to investigate the possible nature of institutional changes which would be required to promote conflict resolution on the basis of full and open discussion and debate of all viewpoints in the absence of domination, whether of an overtly 'political' or implicitly 'ideological' nature.

Such an analysis, then, would hopefully provide valuable further insights into the source of conflicts over public policy issues and the nature of the pre-conditions for a meaningful, open, and fully democratic debate about such issues. It would build on the conclusion of the present analysis that an important pre-condition for such a debate is a reform of both scientific practice and prevailing rationalisations of that practice. This brings us to our third area of further research - that of the relationship between the process of social knowledge development and its social context.

The present analysis has indicated the extent to which we can perceive the influence of an hegemonic framework of ideological knowledge upon the conduct of the debate about nuclear power. Such a framework was conceived in terms of an interrelated set of epistemological and theoretical structures with both descriptive and evaluative

components. Thus, the framework on the one hand purports to describe the way in which social knowledge is developed, the nature of the social world and the way in which knowledge is utilized in informing social action, and, on the other hand, provides certain imperatives, based on these descriptions, on the way in which knowledge should be developed and utilized and implies evaluations about the nature of the social world. In chapter 9 I attempted to indicate the way in which the evaluative themes structure the conduct of the debate in terms of forms of 'rational' argument, perceptions of the nature of the 'energy problem' and approaches to the solution of the 'problem-as-perceived'. The implication is that far-reaching changes in the dominant modes of thinking about social and technological development would be required as a pre-condition for changes in the conduct of the debate about issues related to such development. However, this then raises the question of the kinds of changes to the social and institutional context which might be necessary to support reforms in our social science and philosophy.

This is essentially a research problem in the field of the sociology of knowledge. The primary issue concerns the degree and form of influence of social, economic and political structures on the process of production of social knowledge. We need to gain a better understanding of the extent to which it would be possible to institute 'reforms' in this process without fundamental changes to social and institutional structures. Alternatively, we need to know what kinds of changes in the latter would be required to permit desired reforms. As regards the present analysis the conclusions lead to arguments for reforms in two respects. Firstly, I have argued that the actual nature of social knowledge in our society is rather different from the dominant conception of it and that the latter performs an important legitimacy function; consequently, we need to reform our dominant

conception of the nature of social knowledge. Secondly, having done this, and having recognised the crucial role of scientific ethics in determining the 'scientific quality' of social knowledge, we need to institute a system of ethics which will ensure 'good' social science.

Therefore, we need a better understanding of the kind of social and institutional changes which would be required to permit such reforms. I have hypothesised for this study that the present structure of ideological social knowledge is related to certain aspects of the social and political context, specifically through the role of the state in defining and attempting to solve major problems related to capital accumulation and the maintenance of stability. I have indicated that this hypothesis requires further analysis and this would provide a basis for assessing the prospects for and approach to reform, the crucial question being, perhaps, the degree of 'determinism' in the above hypothesised relationship. To what extent, then, are a particular system of social relations and its legitimising ideological structure mutually reinforcing and interdependent? To what extent have we got the science that we deserve?

It may be, therefore, that systems of scientific ethics are basically a function of the characteristics of the social and political context and that if we lived in a society which promoted the full and open debate between competing value-contingent viewpoints then the establishment of an effective scientific ethics would be a 'trivial' problem. This is undoubtedly a very difficult research area and it is also one which has been rather neglected by many philosophers of science in their concern to outline the way in which they feel science should be undertaken. For example, Paul Feyerabend (1970, 1975) presents a conception of the 'desirable' form of scientific activity

from the point of view of promoting wider social goals. Specifically he argues that the overriding goals of scientific activity should be the maximum development of the liberty and freedom of individual humans and of their capacity to enjoy life and that this goal is best served by methodological, theoretical and ideological pluralism. Rejecting the notion of methodological guarantees of objectivity, he argues that any methodology should be permitted and encouraged thus leading to a proliferation of theories; that confrontation of rival theories will force implicit assumptions out into the open and promote debate and criticism of them; and that the individual should be presented with a choice of 'ideologies' amongst which science is only one. In short, 'anything goes': ... "it is up to us to choose either a dragon or a pussy cat for our company." (op. cit. 1970 p. 229).

However, Feyerabend would appear to underestimate the constraints on our freedom to choose our science deriving from the social and institutional context. It is very easy to posit ideals, to suggest that, for example, the arguments in the debate about nuclear power should be developed within a plurality of approaches set in a context which permitted, and indeed encouraged, mutual open criticism and debate, in such a way that progress could be made both towards a better knowledge of the world and towards the goals of greater democracy and freedom. The problem is: to what extent could such radical changes in our approach to science be achieved only as part of a programme of fundamental social and political change? To extend Feyerabend's analogy, it could be argued that if we are currently lumbered with a dragon and we want a pussy cat then we must do two things: firstly, we need to dispose of the dragon; and secondly, we must create an environment in which our pussy cat can survive and prosper.

Ravetz (1971) also considers the issue of scientific reform though placing more emphasis on its social context and the central role of ethics. He argues that the conditions for an 'effective' scientific ethics have been eroded in modern industrial society but, while emphasising the dependence of ethics on the social and cultural context of scientific activity, he discusses the issue of 'ethical reform' without fully tackling the problem of the nature of the social and political changes which might be necessary to support such reform. Thus, he argues that the ethical basis for ... "the future excellence of science".... perhaps lies in a ... "humanitarian commitment, necessarily interpreted in a much more sophisticated fashion than ever before" (op. cit. p. 313). However, he does not indicate the nature of the social and political changes which would be necessary to support the development of such a commitment into a primary motivating ethic for the scientific community, notwithstanding the present motivation of some scientists by humanitarian concerns. In spite of recognised serious impediments in the present social context, however, he sees hope in a 'critical science' motivated by such concerns:

"(I)f the style of critical science, imposed by the very nature of its problems, becomes incorporated into a coherent philosophy of science, it will provide the basis for a transformation of scientific inquiry as deep as that which occurred in early modern Europe. The problems, the methods, and the objects of inquiry of a matured and coherent critical science will be very different from those of academic science or technology as they have developed up to now; and together they can provide a practical foundation for a new conception of humanity in its relations with itself and the rest of nature." (op. cit. p. 428-9)

It is evident, then, that the studies undertaken for this thesis represent a very small achievement in the context of a broader concern with the role of knowledge in informing social action. Nevertheless, I would personally hope that the analysis makes some contribution to



improving the basis for an understanding of how we might move towards a freer, more equal and more democratic society. Given my perspective on the nature of social knowledge, there is always likely to be disagreement about the role of such knowledge in achieving a 'better world'. Some, following Bertrand Russell, for example, will see intelligence as paramount; others will emphasise the role of political power. However, whatever the relative role of 'rationality' and 'power' may be (and it is likely to vary considerably in different circumstances) it is evident that the scientific community has a very important role to play. From a context in which humankind lives under the threat of annihilation from the technological 'fruits' of its own ingenuity, in the development of which the scientific community has played a crucial part, one might reasonably question the grounds for optimism. However, a moment's reflection on the improbability of our very existence, and on the amount of human effort and inspiration invested by our ancestors to get us where we are today, should be sufficient to re-establish an optimism based upon a conviction that what we have is far too precious to place in jeopardy and, moreover, that we can make the world a better place for those who will follow. As Noam Chomsky (1972 p. 83) argues, quoting Russell's vision of the world we must seek:

"(I)t would be tragic if those who are fortunate enough to live in the advanced societies of the West were to forget or abandon the hope that our world can be transformed to 'a world in which the creative spirit is alive, in which life is an adventure full of hope and joy, based rather upon the impulse to construct than upon the desire to retain what we possess or to seize what is possessed by others' .....

'Meantime, the world in which we exist has other aims. But it will pass away, burned up in the fire of its own hot passions; and from its ashes will spring a new and younger world, full of fresh hope, with the light of morning in its eyes'."

Annex 1    References for Review of UK Energy Policy

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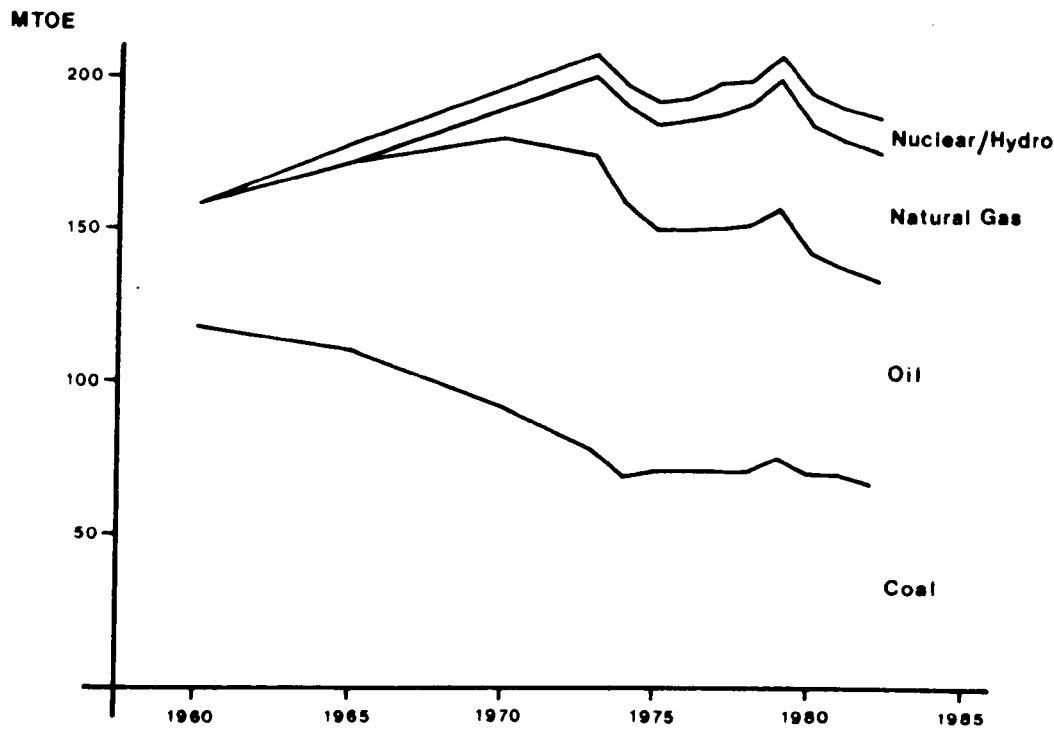
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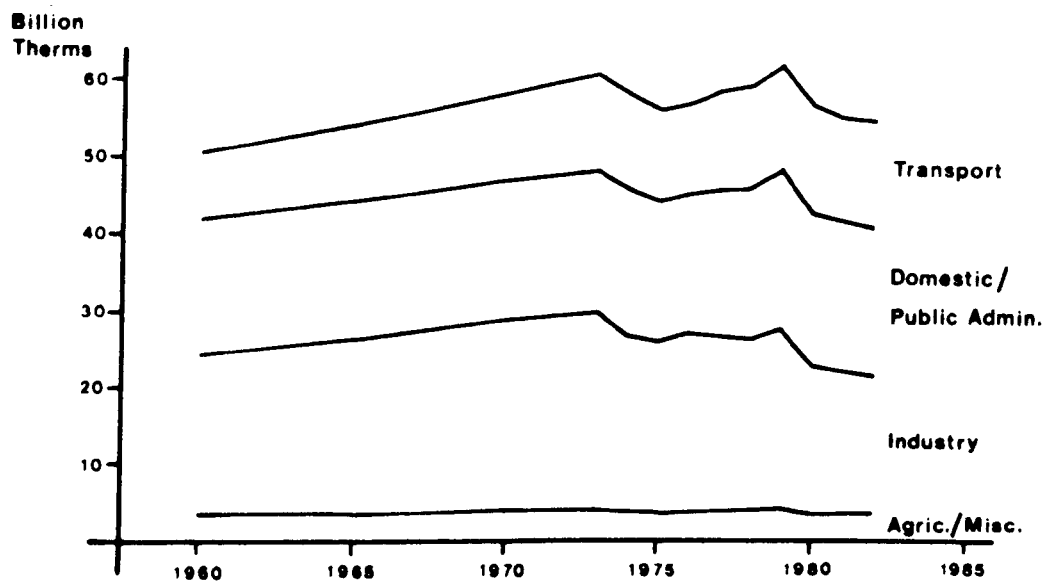
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Figure 1.1 UK Primary Energy Consumption 1960-82



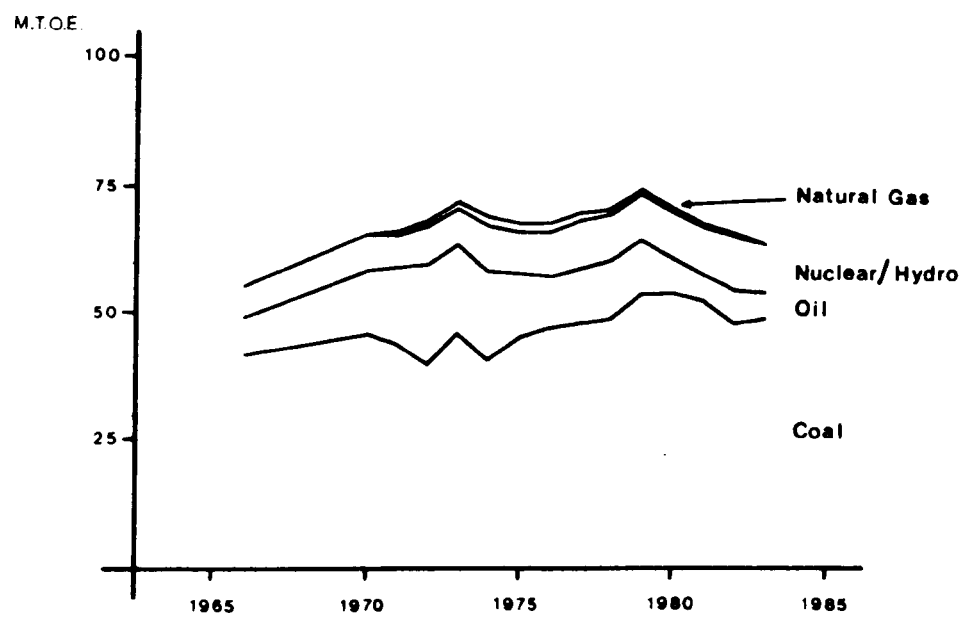
Source: Digest of UK Energy Statistics

Figure 1.2 UK Final Energy Consumption(Heat Supplied) 1960-82



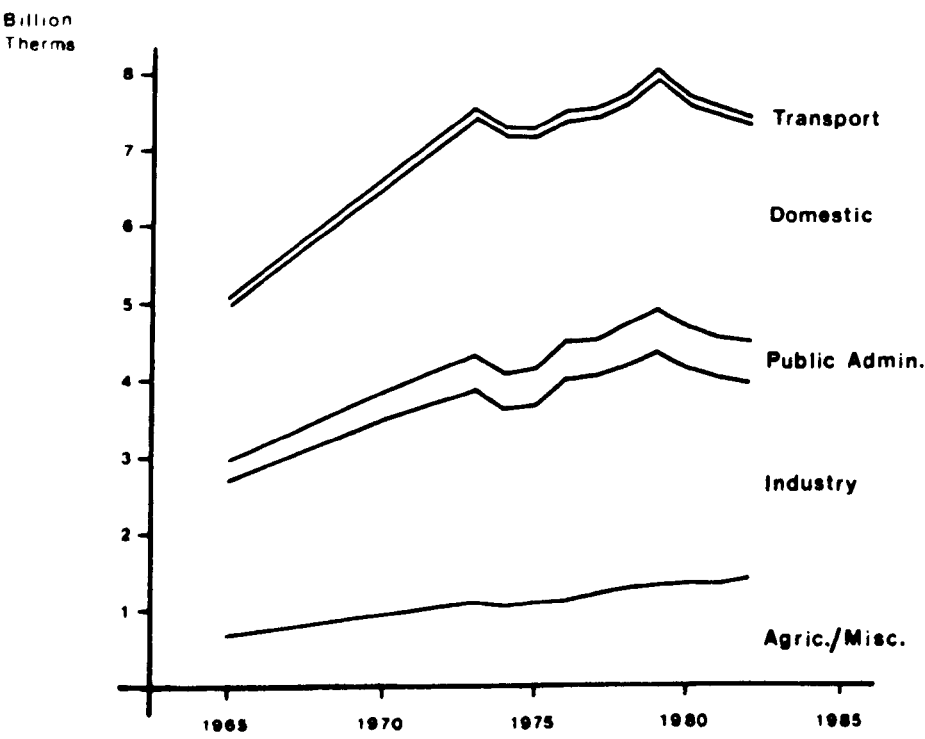
Source: Digest of UK Energy Statistics

**Figure 1.3    Fuel Used in Electricity Generation in the UK 1966-83**



Source : Digest of UK Energy Statistics

**Figure 1.4    Electricity Consumption by Final User Sector in the UK 1965-82**



Source : Digest of UK Energy Statistics

Annex 2: Comparative Generation Costs of Nuclear and Fossil- Fuelled

Power Stations

Table A1: Comparative Generation Costs for Major Power Stations

Commissioned Between 1965 and 1977 (p/KWh)

	Costing System			
	I	II	III	IV
<b>A. Nuclear (Magnox)</b>				
Capital charges (incl. provision for decommissioning)	0.43	1.57	1.45	1.41
Inclusive Fuel Cost	1.21	1.38	0.82	0.88
Other Costs of Operation (incl. research & training)	0.42	0.42	0.33	0.34
Total Cost	2.06	3.37	2.60	2.63
<b>B. Coal-Fired</b>				
Capital charges (incl. provision for decommissioning)	0.10	0.33	0.48	0.40
Inclusive Fuel Cost	1.72	1.72	1.51	1.84
Other Costs of Operation (incl. research & training)	0.23	0.23	0.20	0.22
Total Cost	2.05	2.28	2.19	2.46
<b>C. Oil-Fired</b>				
Capital charges (incl. provision for decommissioning)	0.27	0.92	0.57	0.79
Inclusive Fuel Cost	2.68	2.68	1.76	2.10
Other Costs of Operation (incl. research & training)	0.27	0.27	0.16	0.18
Total Cost	3.22	3.87	2.49	3.07

Notes on Table A1

1. Power stations covered are:

Nuclear (Magnox): Dungeness A, Sizewell A, Hinkley Point A, Oldbury, Trawsfynydd, Wylfa;  
 Coal: Tilbury B, Ferrybridge C, Aberthaw B, Fiddlers Ferry, Drakelow C, Ironbridge B, Rugeley B, Cottam, Ratcliffe, West Burton, Eggborough Didcot;  
 Oil: Fawley, Pembroke

2. Alternative costing systems are as follows:

- I : Generation costs for 1981-82 on monetary interest cost basis: costs allocated to one year's generation reflect money values and interest rates in years in which they are incurred.
  - II : Generation costs for 1981-82 on opportunity cost basis with 5% discount rate: Costs allocated to one year's generation converted to prices in that year and annuitised assuming 5% opportunity cost of capital;
  - III: Generation costs of lifetime to 1982 on opportunity cost basis with 5% discount rate: Costs allocated on time-related basis from commissioning date to 1981/82 converted to 1982 values and discounted to commissioning date assuming 5% opportunity cost of capital.
  - IV : Generation costs over whole lifetime on 5% opportunity cost basis: Past and forecast future costs up to and including decommissioning expressed in 1982 values and discounted or compounded to commissioning date at 5% opportunity cost rate.
3. 'Capital Charges' include the original capital cost of each station in each year of construction and extra miscellaneous capital expenditure (eg improved or post-commissioning site facilities); for nuclear stations an annual sum is included to cover the net costs of decommissioning and the cost of decommissioning BNFL's reprocessing plant at Sellafield.
  4. 'Inclusive Fuel Cost': costs of fuel consumed, of reprocessing spent fuel and of disposing of waste material.
  5. 'Other Operating Costs' include salaries and other operating, repair and maintenance costs and an estimate of expenditure on research and training allocable to each station type.
  6. Where future costs are involved expected real increases in prices of fuel, nuclear fuel reprocessing and construction costs have been built in; for fuel assumed real increases are coal 2% p.a. from 1984-85, oil 3% p.a. and uranium ore 3% p.a.
  7. Assumed operating lives are coal 40 yrs, oil 30 yrs and nuclear (Magnox and AGR) 25 yrs (20 years for Wylfa).
  8. Source CEGB (1983).

Table A2: Comparative Generation Costs for Hinkley Point B and  
Drax First Half (p/KWh)

	Costing System			
	I	II	III	IV
<b>A. Hinkley Point B</b>				
Capital charges (incl. provision for decommissioning)	0.51	1.03	1.63	1.14
Inclusive Fuel Cost	0.77	0.85	0.92	0.93
Other Costs of Operation (incl. research & training)	0.29	0.29	0.37	0.32
Total Cost	1.57	2.17	2.92	2.39
<b>B. Drax First Half</b>				
Capital charges (incl. provision for decommissioning)	0.21	0.47	0.50	0.43
Inclusive Fuel Cost	1.59	1.59	1.61	1.02
Other Costs of Operation (incl. research & training)	0.24	0.24	0.19	0.22
Total Cost	2.04	2.30	2.30	2.67

Notes on Table A2

1. See notes on Table A1.
2. Source CEGB (1983)

**Table A3: Comparative Lifetime Generation Costs of Nuclear and Coal Power Stations Under**

Construction (p/kWh)

	Nuclear				Coal	
	Dungeness B	Hartlepool	Heysham I	Heysham II	Drax	Second Half
Capital Charges (incl. provision for decommissioning)	2.97	2.06	1.88	2.09	0.74	
Inclusive Fuel Cost	0.88	0.77	0.75	0.72	2.40	
Other Costs of Operation (incl. research & training)	0.33	0.32	0.32	0.33	0.24	
Total Cost	4.18	3.14	2.95	3.14	3.38	

Notes on Table A3

1. Actual and forecast costs are converted to 1982 money values and compounded or discounted to commissioning date assuming 5% opportunity cost of capital
2. For assumptions on station lifetimes and future rates of real cost increase see Notes to Table A1
3. Source: CEGB (1983)



Table A4: Comparative Net Effective Costs for Sizewell B, AGR, and Coal-Fired Stations under Different Scenarios and Nuclear Backgrounds (£/KW p.a. March 1982 prices)

	Nuclear Background		
	No new Nuclear	Medium Nuclear	High Nuclear
<b>Scenario A</b>			
Sizewell B	-138	-121	-92
AGR station	-92	-	-
Coal-fired station	-3	-4	-2
<b>Scenario B</b>			
Sizewell B	-143	-128	-108
AGR station	-111	-	-
Coal-fired station	-24	-25	-24
<b>Scenario C</b>			
Sizewell B	-83	-63	-32
AGR station	-46	-24	-9
Coal-fired station	21	17	26
<b>Scenario E</b>			
Sizewell B	-25	-25	-3
AGR station	-14	-	-
Coal-fired station	46	46	49

Notes on Table A4

- 'Nuclear Backgrounds' comprise alternative assumptions concerning the development of generating plant mix after the construction of Sizewell B
  - No new nuclear = no new nuclear construction after Heysham II
  - Medium nuclear = nuclear capacity builds up to 40% of total
  - High nuclear = nuclear capacity builds up to 70% of total
- Scenarios represent alternative sets of assumptions about growth in electricity demand between, 1979/80 and 2030:
  - Scenario A + 27%
  - Scenario B + 56%
  - Scenario C + 15%
  - Scenario E - 16%
- AGR station is assumed to be of the type under construction at Heysham II and coal-fired station of the type constructed at Drax; for other assumptions see Table A5.
- Source: Jenkin(1982).

**Table A5: Components of Net Effective Costs for Sizewell B and Coal-Fired Station in Scenario C (£/KW p.a. March 1982 prices)**

	Nuclear Background			
	No new nuclear		High nuclear	
	Sizewell B	Coal Station	Sizewell B	Coal Station
Capital charges	91	50	91	50
Decommissioning Cost	1	0	1	0
Fuel Cost	36	177	29	117
Other Costs	10	10	10	10
Total Generation Cost	138	237	131	177
Savings	-221	-216	-163	-151
Net Effective Cost	-83	21	-32	26

**Notes on Table A5**

1. Capital costs do not include initial fuel for nuclear stations; construction period assumed to be 90 months for Sizewell and 80 months for coal station; interest during construction assumed as 28% of capital cost for Sizewell and 21% for coal station.
2. Life of Sizewell assumed to be 35 years and average annual availability 64%; equivalent figures for coal station are 40 years and 72%.
3. Coal prices assumed to increase from mid 1980s by about 3% p.a.; lifetime average nuclear fuel cycle costs for Sizewell assumed as 0.58 - 0.62 p/KWh.
4. Source: Jenkin (1982)

Annex 3: The Safety of Nuclear PowerA. Routine Radiation EmissionTable A1: ICRP Recommended Annual Dose Limits

Occupational Exposure	
Whole Body	5 rem p.a.
Maximum to any tissue	50 rem p.a.
Eye Lens	15 rem p.a.
Public Exposure	
Whole Body	0.5 rem p.a.
Maximum to any tissue	5 rem p.a.

Source: Bonnell (1982 p. 12-13); Wade (1981) p. 294)

Table A2: Maximum Exposures Resulting from the Nuclear Industry

Compared with ICRP Dose Limits

Source	Critical Pathway	Individual Dose (Max). as % of ICRP Limit
UKAEA		
Winfri th	Shellfish	<0.2
Hawell	Drinking Water	<1.0
Dounreay	External dose	<1.0
BNFL		
Windscale	Fish/shellfish	30.0
Springfields	External dose	<1.0
Chapelcross	External dose/shell- fish	<1.0
CEGB		
Berkeley/Oldbury	External dose/fish	<0.1
Bradwell	Fish	<0.3
Dungeness A	External dose/fish	<0.1
Hinkley Point A	External dose/fish	<0.2
Sizewell A	External dose/fish	<0.2
Trawsfynydd	Lake fish	3.0
Wylfa	External dose/fish	<0.1

Notes

1. Data relates to 1977
2. Windscale figure was expected to reduce as new plant was commissioned.
3. Source: Wade (1981 p. 295).

Table A3: Average Annual Per Capita Radiation Doses in the UK

Source	Effective Whole-Body Dose Equivalent (rem)
<b>Natural Background</b>	0.186
Minimum (London)	0.160
Maximum (Aberdeen)	0.250
<b>Medical Applications</b>	0.050
<b>Fallout from Weapons Tests</b>	
1963-64	0.006 - 0.008
1977	0.001
<b>Miscellaneous Sources</b>	0.0008
<b>Nuclear Power Generation</b>	0.0003

Notes

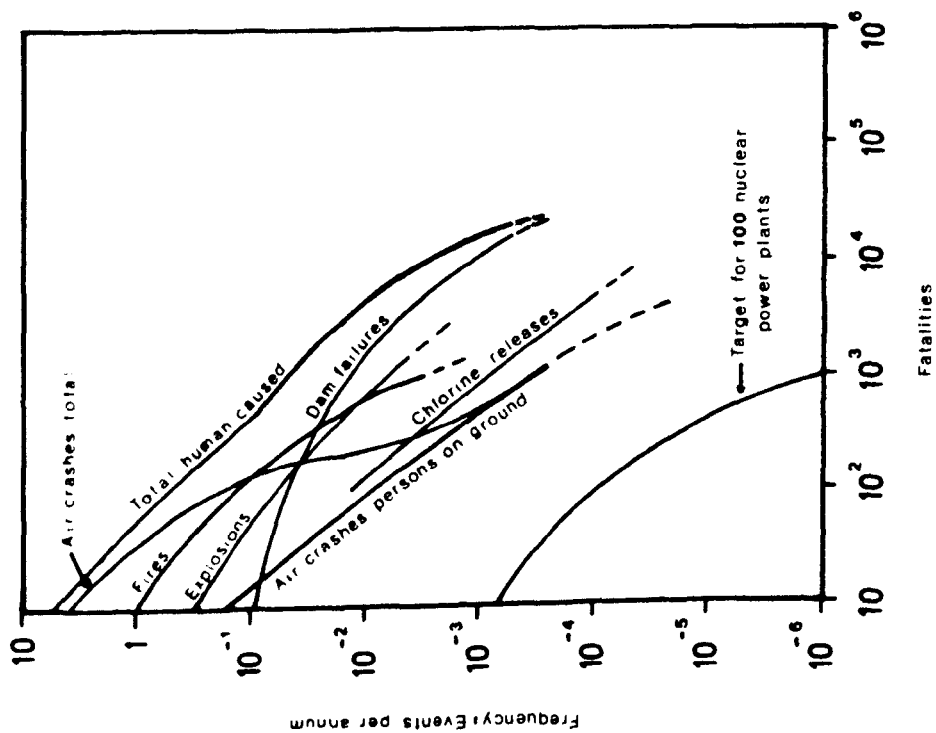
1. Data show exposure of public based on NRPB publications in 1974 and 1978.
2. Source: CEGB (1982A p. 70); Wade (1981 p. 295).

**B. The Risk of Major Accident**

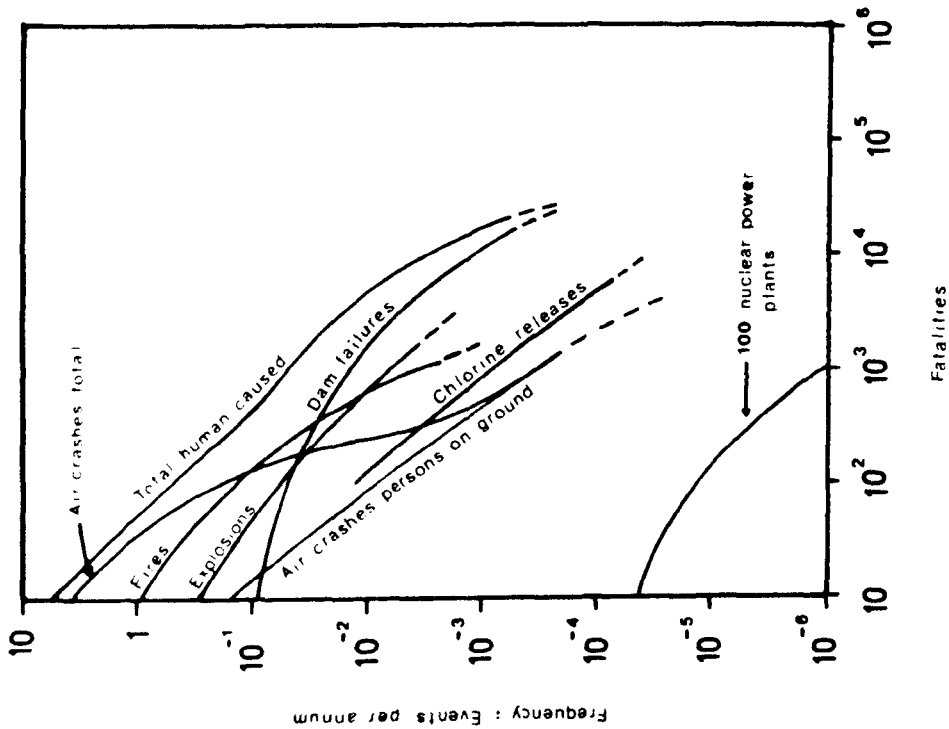
See Figure B1 (over)

**Figure B1. Target Accident Probabilities for 100 Nuclear Power Plants Compared with Other Human-Made Hazards.**

**a). After the USNRC.**



**b) As Used by the UK Nuclear Industry**



**Source: Flowers (1976), Hill (1978)**

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